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Determination of Optimum Light Source Radiation Wavelengths and Intensities in the Reproduction of Color Holographic Images

18600122a TEKHNIKA KINO I TELEVIDENIYA in Russian No 1, Jan 89 pp 10-14

[Article by V. G. Komar, I. F. Podlivaev, A. K. Filonov, and I. V. Khesina]

[Abstract] This study presents research results representing a further development of previous studies and provides optimum wavelengths and radiation intensities for laser light sources corresponding to minimum color transmission distortions in the recording-reproduction of color holographic images. The optimum wavelengths were determined based on minimum color transmission distortion. The holographic process was adopted as the ideal process in a first approximation since it ignores light scattering and the nonlinearity of the diffraction characteristic. The calculations yielded optimum wavelength values for the case of 3, 4, or 5 radiation lines as well as the relative radiation intensities for generating the image. The study determines that three radiation lines are sufficient to achieve high color transmission quality in the holographic process. Wavelength deviations from the optimum values do not cause any loss of color transmission integrity if the deviations lie within the following ranges for the x, y, and z axes: .60 plus or minus .01 micrometers; .52 plus or minus .01 micrometers, and .44 plus or minus .02 micrometers.

Telecines for High-Definition Television

18600122b TEKHNIKA KINO I TELEVIDENIYA in Russian No 1, Jan 89 pp 18-22

[Article by L. A. Polosin, V. N. Roldugin, and T. A. Tarasova]

[Abstract] This article is a survey study of existing telecines and their possible application to high-definition television. The article initially discusses the principles of telecine projection and covers the primary features of telecine projection for application to high-definition television, specifically the altered frame format of 16:9 = 1.78. This format was proposed by the North American National Broadcasting Association in conjunction with the American Association of Cinematographers. The article also reviews laser telecines as well as traveling-wave laser telecine designs. Existing CCD strips used in telecines are also reviewed. This comparative analysis that concludes that based on the excellent qualitative and performance characteristics of CCD telecines, the progress in developing CCD image converters and improvements in the speed of digital signal processors as well as sucesses in the integration of high-definition television telecines with standard telecines preference should be given to CCD telecines for television broadcasting applications.

Expandable Sound Equipment for Central Control Rooms

18600122c TEKHNIKA KINO I TELEVIDENIYA in Russian No 1, Jan 89, p 57

[Article by A. V. Vinogradov, A. A. Shevchenko]

[Abstract] This study reports the development of an expandable audio sound system for central control rooms; such a system generates, monitors, and distributes television sound signals for broadcast. Stereo or two-channel mono television sound signals are switched and distributed in this system. The system includes three primary subsystems: the television sound signal switching and distribution system, the monitoring system and service (technical) communications. The system allows both visual and audio monitoring of television sound signal level and quality. All programming signals are monitored on the control panel. A 12 subscriber technical communications system and a three-line telephone system are used for ongoing coordination of crew and talent personnel involved in television programming. The system has internal diagnostic capability and fault display.

Electrical Strength of Polyethylene-Insulated Cables Carrying Millisecond Pulses

18600123g Moscow ELEKTROTEKHNIKA in Russian No 5, Jan 89 pp 59-61

[Article by E. A. Belinskiy, F. I. Goncharov, A. S. Kudratilayev, V. N. Lagunov, and A. K. Yuldashev]

[Abstract] This study carries out an analysis of the electrical strength of polyethylene-insulated cables to determine the breakdown voltage in different operating conditions. Cable specimens with 5 mm thick insulation and both with and without a screen on the current-carrying conductor along with 9 mm thick insulation with a screened conductor were tested. The current-carrying conductor in the 10 mm^2 (cross-section) cables consisted of 7 copper wires, each with a diameter of 1.37 mm. The test cable specimens were placed in a grounded vessel containing a saline solution. The tests revealed that the electrical strength of the insulation for d.c. voltage exceeded by only 3.5 percent the electrical strength in lightening pulse conditions for unshielded cables. The electrical strength of the 5 mm thick insulation for these cases was 41.4 kV per mm and 40 kV per mm, respectively. These effectiveness of a semiconducting polyethylene screen applied to the current-carrying conductor was confirmed.

Optical Cables. Current Status and Developmental Prospects

18600123a Moscow ELEKTROTEKHNIKA in Russian No 5, Jan 89 pp 5-7

[Article by G. G. Devyatykh, Ye. M. Dianov, I. B. Peshkov, and A. M. Prokhorov]

[Abstract] This is a survey article devoted to a broad analysis of the fundamental circuit engineering, design,

and fabrication techniques for optical cables used in fiber-optic communications links. After a brief discussion of the history of the development of optical fiber design this survey discusses some of the most recent interesting research results in the field, including the investigation of the effect of polymer fiber sheathings on optical losses and the conclusion that the precipitous rise in optical losses in optical fibers occurring at temperatures below -40°C is due to crystallization of the organic silicon elastomer in the primary jacketing. Also discussed are the initial prototype designs of freezing-resistant optical cables with additional losses of less than 1 dB per km in the -120 to +185°C range. The study considers several other aspects including optical fiber strength, the constants characterizing fiber strength degradation, degradation produced by chemical breakdown of the glass surface, and several other factors. The study also identifies future tasks in the field of optical cable manufacturing and design, including reduction of the attenuation of series-manufactured monomode optical fiber preforms and cables to below 0.3 dB per km at 1.55 mcm. Another area for future improvement is the development of new, more efficient methods of fabricating preforms for optical fibers and the necessary industrial support equipment and sharply increasing the output of finished products in the manufacture of preforms, fibers, and cables.

Optical Fibers in Electrical Engineering Applications

18600123b Moscow ELEKTROTEKHNIKA in Russian No 5, Jan 89 pp 7-10

[Article by V. D. Verbitskiy and V. S. Gorshkov]

[Abstract] This article describes experimental and prototype designs of four types of high-voltage optical fibers and reports mechanical strength, all-weather performance characteristics and other data on these optical fibers. The four types of fibers are: type 1) flexible high-voltage optical fiber with a "dry" lightguide fiber; 2) a high-voltage flexible-type optical fiber employing waterproofing of the lightguiding fibers (one-channel design); 3) high-voltage flexible-type optical fiber with complete waterproofing of the optical fiber (single channel design); 4) high-voltage flexible-type optical fiber in rod design configuration (single-channel design). The weather tests were performed on optical fibers .5-1.5 m in length. The test results revealed that designs 3 and 4 satisfied the requirements imposed on outdoor glass-plastic electrical insulation materials. Long-term voltage tests revealed that optical fiber designs 3 and 4 withstood voltage levels of 3 kV per cm for 20,000 hours with no internal fiber nor system failures. The overall analyses suggest that optical fiber designs 3 and 4 are suitable for application in electrical equipment and high-voltage class U equipment for installation categories 1, 2, 3, and 4, while type 2 high-voltage optical fibers are suitable for installation categories 3 and 4, and type 1 high- voltage optical fibers are suitable for equipment and devices of installation category 4.

Investigation and Calculation of the Parameters of Radiating Cables

18600123d Moscow ELEKTROTEKHNIKA in Russian No 5, Jan 89 pp 23-27

[Article by M. F. Popov, P. R. Basanskaya, N. I. Dorezyuk, V. N. Korotkov, and A. V. Lobanov]

[Abstract] This study carries out an investigation and analysis of the primary electrical parameters of radiating cables such as the wave impedance, attenuation factor and a functionally-specialized parameter characterizing the radiative properties of the cable: the coupling losses averaged over cable length. The article also analyzes such properties of radiating cables as the electromagnetic field energy radiated into space, the transient conductivity and the coupling impedance. These properties of several types of cables were analyzed and their theoretical and experimental values were compared. Analysis revealed that fine-braided cables have a high attenuation factor and poorer radiative properties, even at substantial impedances. Interlaced-braided cables can provide radiation levels equal to that of cables with an outer conductor in the form of perforated foil, although their attenuation factor is substantially greater, particularly at high frequencies. Cables employing strip coil outer conductors have a somewhat lower radiation level and higher losses compared to cables with a perforated outer conductor yet such losses are substantially lower than for braided cable. Finally, the best electrical performance characteristics belong to radiating cables with an outer conductor in the form of an intact perforated foil. The RI50-7-11 brand of radiating coil currently manufactured has such an outer conductor.

Procedure for Efficient Selection of Cables and Wires for Industrial Electrical Products

18600123e Moscow ELEKTROTEKHNIKA in Russian No 5, Jan 89 pp 27-30

[Article by M. A. Boyev and A. I. Zaikin]

[Abstract] This article proposes and substantiates a routine for efficient selection of cables and wiring used in industrial electrical equipment. Functional cost analysis is recommended for selection of a specific cable or wire brand; the purpose of this routine is to satisfy certain given requirements with minimum cost. The study recommends that the following stages be observed in the functional cost analysis routine: 1) the information stage, involving the process of obtaining data on operating conditions, applications, and specifications for the cable or wire; 2) the analytical stage where the technical requirements are processed and analyzed and the primary cable or wire functions are determined; 3) the creative stage which involves searching for various wire and cable designs to achieve primary functions; 4) the

research stage involving analysis of different variants to assess their cost, easy of manufacture, utilization of expensive materials or materials in short supply, and operational reliability within the target device and, finally, the recommendation stage involving issuance of recommendations to the user. The study also concludes that since many different cables and wires can be used for identical functions it is best to rank cable or wire functions in order of importance. The following ranking is proposed: 1) nominal operating voltage and possible overvoltage levels; 2) current frequency; 3) nominal long-term current load, levels over nominal, and duration of such levels; 4) type of installation (fixed or mobile); 5) operating temperature range, extreme temperature exposure; 6) service life and payback period.

Flexible Automated Manufacturing of Municiple Telephone Cables

18600123f Moscow ELEKTROTEKHNIKA in Russian No 5, Jan 89 pp 37-41

[Article by G. N. Shlyakhter, G. N. Ulyanov, G. I. Lutsenko, O. Miyetinen, A. Riyekinen]

[Abstract] This article This article is a survey article of the various hierarchical divisions and sections in flexible automated manufacturing of municiple telephone cables. The study analyzes flexible manufacturing systems and their component parts as well as the operation, management, and function, of flexible automated manufacturing shops. The component sections of a flexible automated shop are analyzed including the copper preform fabrication section, the insulated current-carrying conductor fabrication section, the nine- pair wire bundle manufacturing section, the 30-50-100 pair cable manufacturing section, together with the automated technological process control system divisions such as the automated coil, container, and drum transport and storage system, the automated granular plastic storage and transport system, and the hierarchical automated control and management system for flexible automated manufacturing shops. The advantages in speed and productivity from the incorporation of flexible automated manufacturing of municiple telephone cables are discussed.

Video Signal Spectral Compression in a High-Definition Telesine System

18600141b TEKHNIKA KINO I TELEVIDENIYA in Russian No 2, Feb 89, pp 21-26

[Article by O. S. Novakovskaya]

[Abstract]This article examines one possible spectral compression method for compressing the initial luminance signal of a telecine system to 6 MHz (or for compressing a composite color television video signal with time-division signal multiplexing of the luminance and chrominance signals) for bandwidths of 1250 and 3600 MHz. This design involves blanking the signal band during the transmission of a complete frame and recording on tape only the signals from one-half the image elements, while the signals from the unrecorded elements are restored in the receiver by interpolation as is currently done in the MUSE system. This spectral compression technique employs interlaced digitization (thereby reducing the signal sampling rate by a factor of 6) and transmission of the derived sample envelope to the receiver.

A Digital HD TV video tape recorder for $Y/P_R/P_B$ Signals at Bandwidths of 30/15/15 MHz

18600141c TEKHNIKA KINO I TELEVIDENIYA in Russian No 2, Feb 89 pp 48-52

[Article by V. A. Khleborodov]

[Abstract] This article reviews the new Sony model HDD-1000 series- manufactured HD TV VTR for $Y/P_R/P_B$ signals with bandwidths of 30/15/15 MHz. This system employs the tape-drive mechanism from the VVH-3000 video tape recorder (C standard) which is a compact, highly reliable, low drag mechanism. The control system in this model has been replaced with a front-panel automated/computerized control system. The head speed has been doubled to 120 S^{-1} while the tape speed has been increased to 805.2 m/s, i.e., by a factor of 3.3. The resulting recording speed is 51.5 m/s. The article also provides the designs of the rotating head drum for the HDD-1000 as well as a digital video recording image for the 1125/60 standard used by this unit. Such aspects as the recording/playback head configuration, video field recording layout and performance specifications of the unit are also provided.

Magnetic Tape Recorders in 1982

18600177a RADIO in Russian No 2, Feb 89 pp 50-54

[Article by A. Nesterenko, S. Olifirenko, Yu. Smironv, V. Shimilis]

[Abstract] This article is a survey of the current state of domestically- manufactured fixed and portable magnetic tape recorders. A rather comprehensive survey of the primary models and brands currently available on the Soviet domestic market is given. The technical specifications of such units are provided including the total harmonic distortion, operational frequency range, signal-to-noise ratio, output and nominal power levels, weight and price as well as a list of primary unit functions. The general low level of product quality and technology in such units is cited, particularly with respect to units designed and manufactured prior to 1986. Acute shortages of suitable integrated circuits and other components and elements make it difficult to design domestic magnetic tape recorders that are comparable to units manufactured by other nations. In spite of such shortages several Soviet enterprises will begin to manufacture compact magnetic tape recorders in the near future. The "Elektronika-mini stereo" magnetic tape recorder is the most promising such unit. This is a compact tape recorder with a low voltage operating level

(3 V), has two-channel stereo recording capacity as well as an internal microphone and the capability to record from an external stereo source.

Applications of the K174PS1 Integrated Circuit

18600177b RADIO in Russian No 2, Feb 89 pp 55-56

[Article by V. Bondarev, A. Rukavishnikov]

[Abstract] This article analyzes several applications of the K174PS1 integrated circuit and also provides its primary operating specifications. The specifications are as follows: conversion transconductance, milliamps per volt, greater than 4.5; noise factor, dB, less than 8; stabilization voltage, volts, less than 1; input voltage, volts, less than 1; supply voltage, volts, 9 plus or minus 10%, power consumption, milliamps, less than 2.5; weight in 201.14-1 package, grams, less than 1.5. This integrated circuit is a balanced mixer. Possible applications include a differential amplifier with a tunable bandwidth and variable gain. Another possible application is as a resonance amplifier with a gain of approximately 20 dB tunable over the range 160 kHz to 230 MHz. The circuit can also be used for detecting balance-modulated signals in synchronous decoder detectors in color television sets and in the frequency converter of a radio broadcast receiver.

Polarization Structure of Diffracted Radiation Propagating in a Turbulent Atmosphere

18600113i Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian
Vol 33, No 11, Nov 88 pp 2399-2408

[Article by A. I. Deryugina, V. N. Kurashov]

[Abstract] This study carries out a theoretical analysis of the depolarization of spatial-polarization-modulated optical signals propagating in a turbulent atmosphere. The study identifies an additional powerful depolarization source attributable to the decorrelation of the initial orthogonally-polarized components of optical signals propagating in a random medium. The decorrelation of the polarization components of coherent radiation propagating in a turbulent atmospheric channel is the primary cause of depolarization in both imaging and nonimaging diffraction systems where the polarization distribution is inhomogeneous across the radiator. The quantitative estimates reveal that this effect is quite substantial for optical sources and in certain cases can result in near-complete depolarization of radiation. This limits the capabilities of polarization techniques of analyzing the resulting fields, which may be important in designing systems based on these techniques.

Synthesis of Radiator Currents to Achieve a Prescribed Reflector Current Distribution

18600113a Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian
Vol 33, No 11, Nov 88 pp 2234-2239

[Article by Y. A. Feld]

[Abstract] This article develops a method of determining the electrical and magnetic surface currents at the aperture of a reflector antenna radiator that provide a given reflector current distribution. The electrical current can also be found by employing the known directional pattern. The analysis concerns a radiator in the form of a dipole or a dipole array with electrical current flow through the array. The reflector surface is closed by a geometrical surface to form a circle with the radiator contained within the circle. This method of calculating the equivalent electrical and magnetic surface currents of the radiator is also applicable to the case where a wire radiator containing a single electrical current is used in place of an "aperture radiator."

Multidimensional Autophasing System Employing Correction Interconnections in the Controller

18600113b Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian
Vol 33, No 11, Nov 88 pp 2239-2248

[Article by S. V. Esin, V. I. Kaganov]

[Abstract] This article analyzes a cyclic-type autophasing system consisting of identical autophasing control circuits. In this design each channel consists of a power amplifier, a phase shifter, and a controller which includes a phase discriminator, a correction filter, an amplifier, and a processor. The error signal at the output of each phase discriminator is generated from a phase comparison of two signals: one signal in the present channel and one in the neighboring channel, which allows joint phasing of the amplifiers without using a reference signal. In order to stabilize the control signals generated in this autophasing system feedback interconnections are employed in the amplifier and correction filter. The average phases of the output signals will not change during the autophasing process, i.e., no parasitic phase modulation of the radiated signals will occur. Additional correction interconnections implemented by means of processors are used to improve phasing quality between the controllers. An analysis and test of this system revealed that the use of additional error signal correction interconnections based on the selected control algorithm improves the accuracy and speed of the autophasing system while maintaining a fixed stability range. The stabilizing properties of the system, determined by means of the invariance coefficient, can be improved by a factor of 10 to 70. The speed of the autophasing system is improved by at least a factor of 5-10.

Self-Consistent Theory of Spin-Wave Excitation by a Microstrip Antenna in a Tangentially-Magnetized Layered Structure

18600113c Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian
Vol 33, No 11, Nov 88 pp 2248-2258

[Article by V. F. Dmitriev, B. A. Kalinikos]

[Abstract] This study formulates a self-consistent theory of microstrip spin wave excitation in a tangentially-magnitized metal-dielectric-ferrite- dielectric-metal layered structure that takes account of both the dipole-dipole and inhomogeneous volumetric interactions. The article derives spin-wave Green's functions to describe the response of the ferromagnetic film to a spatially-inhomogeneous alternating magnetic field. Both experimental results and results from a self-consistent calculation of the radiation resistance of the layered structure for various distances to the metallic screens are given. Analysis reveals that the theory developed here properly describes the nature of the influence of the screens on the behavior of the $R(\omega)$ function. The correlation between theory and experiment is less consistent in the frequency domain where the screens have a negligible influence. The expressions obtained in the present study for the radiation resistance per unit length in conjunction with existing relations from the theory of Lossy lines make it possible to calculate all the primary characteristics of a microstrip antenna, specifically its wave impedance, input impedance, and voltage and current distribution along the antenna.

The Effective Permittivity of the Vegetation Canopy in the Microwave Range(tab)

18600113e Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian
Vol 33, No 11, Nov 88 pp 2310-2319

[Article by A. A. Chukhlantsev]

[Abstract] This study derives expressions for the quasistatic part of the effective permittivity tensor of the vegetation canopy based on wave propagation theory in randomly inhomogeneous media with strongly fluctuating permittivities. The relations generalize existing model approximations used previously to describe the effective permittivity in a quasistatic approximation. The wave corrections to the quasistatic part of the permittivity tensor caused by scattering by inhomogeneities in the vegetation canopy are calculated. By taking account of auxiliary terms that determine the wave corrections to the quasistatic part of the permittivity tensor, an expression is derived for the effective permittivity of the vegetation canopy with a term nonlinear in the vegetation density; this expression qualitatively describes the mutual shielding of elements within the vegetation canopy. A correlation between the electrodynamic and biometric characteristics of the vegetation canopy is established within the framework of this model. The calculated microwave attenuation relations for the vegetation canopy are in qualitative agreement with existing experimental data.

Application of Focused Broadband Antennas to Radio Hydrophysical Research

18600113f Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian
Vol 33, No 11, Nov 88 pp 2319-1322

[Article by A. A. Verevkin, V. V. Dmitriev]

[Abstract] This study calculates the focal spot of a broadband focused parabolic antenna in the 20 and 37.5 GHz bands, carries out an experimental test of the calculation results and evaluates the possibility for investigating the natural radiation from an irregular water surface using a broadband radiometer/focused antenna system. The setup employing the focusing antenna was used to investigate the critical phenomena in the natural radiation from the irregular water surface; these measurements were carried out at a high angular resolution. RF contrasts of approximately 0.1 deg. K were recorded by means of the focused antenna. The analysis and calculations of the broadband focused antenna system demonstrate the promise for its application to experimental problems in radiothermal radiation from various objects over short distances while conserving the angular resolution and improving the sensitivity of the receive equipment operating in a broadband mode.

Ionospheric Diagnostics by Artificial Radio Emission

18600164b IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31, No 11, Nov 89 pp 1301-1308

[Article by L. M. Erukhimov, S. A. Metelev, D. V. Razumov]

[Abstract] Based on the assumption that small-scale ionospheric inhomogeneities can effectively scatter incident electromagnetic radiation and that a reverse transformation of plasma waves into secondary electromagnetic radiation can be produced by such inhomogeneities this study carries out an experiment to investigate artificial ionospheric inhomogeneities produced from preliminary ionospheric heating and probe waves of ordinary polarization. Artificial ionospheric radio emission excited by radio emission from a transmitter that instantaneously switches to pulsed mode was used as the test radiation. Pulses of a few milliseconds in duration did not produce additional ionospheric F-layer heating. The experiment was performed on a "Zimenki" test bed producing an effective radiated power of 20 MW. A polarized antenna with a vertical directional pattern and a gain of 200 located 1.5 km from the transmitting antenna was employed as the receive antenna. Transceivers with bandwidths of 1 kHz and a broad dynamic range at the input signal level were used to amplify the received signals. The measurements carried out in this study made it possible to propose the following technique for diagnostics of artificial inhomogeneities in the electron concentration of plasma by means of artificial radio emission. It is necessary to use a second radio transmitter with carrier frequency tunability for probing the perturbed ionospheric region at high altitudes. The average effective power of this transmitter must be sufficiently low to eliminate undesirable ionospheric perturbation. The probe transmitter power has a lower limit imposed by receiver sensitivity. When CW radiation of 0.5 MW is used as the probe radiation the energy flux will be between 10^{-18} and 10^{-20} W per m^2 per Hz which can be recorded by a rather narrowly-directional antenna. The situation improves for probing by pulsed radiation: the appropriate pulse repetition rate can be used to increase probe radiation power, and the level of the plasma waves which increases the inhomogeneity intensity. The preliminary experiments carried out in this study confirmed the effectiveness of this technique.

Experimental Investigations of the Anisotropy of SHF Radiowave Backscatter by the Sea Surface at Small Glancing Angles

18600164c IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31, No 11, Nov 89 pp 1318-1330

[Article by M. P. Guskov, Yu. M. Zhidko, V. V. Rodin, I. A. Rusakova, O. A. Shikov]

[Abstract] This study is devoted to an investigation of the anisotropy of radiowave scattering by the sea surface

at small glancing angles. The circular surface scanning method and averaging of the derived data over extended observation intervals made it possible to determine with great accuracy the dependence of anisotropy on the glancing angle and the swells. The measurement technique used in the study also suppressed interference factors. The azimuthal angle was varied by rotating the radar antenna at a speed of 30 rpm. The received signal was split by the strobbing system into several ranging channels from 130 to 810 m which corresponded to glancing angles from 9.4 to 1.5 degrees for an antenna altitude of 20 m over the sea surface. Functions for several glancing angles were therefore obtained over two seconds in a single realization. It was determined from the analysis that the sea surface - generated radiowave backscatter diagram is a rather stable characterization of the surface. Variations in the scattering pattern normalized to its maximum value did not exceed plus or minus .2 dB over several observation hours. Radiowave backscattering by the swell waves under irradiation at levels of 0.5 to 1.5 dB are greater than when irradiated along the direction of propagation (in a glancing angle range of 2-9 degrees). It is also demonstrated that the vessel causes significant distortion to the sea surface wave structure at distances of the order of 1 to 2 vessel lengths. This must be taken into account when interpreting the remote sensing data for the see surface by various techniques.

Analysis of Superresolution of Uncorrelated Radiation Sources in Adaptive Arrays

18600164d IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 31, No 11, Nov 89 pp 1374-1379

[Article by A. B. Gershman, V. T. Yermolayev, A. G. Flaksman]

[Abstract] This study derives a resolution criterion for external radiation sources that is valid for superresolution techniques employing the idea of determination of the matrix projected onto the internal noise subspace. The analysis is carried out for the case of two sources of identical power. The influence of random error associated with using a maximum likelihood estimate rather than an exact correlation matrix of input oscillations is investigated for the case of a random number of sources. A formula is also obtained for the case of a random number of sources of different power levels for the dispersion of fluctuations of spectral estimates which makes it possible to find the accuracy of determination of the correlation matrix of the input signals in the antenna array elements necessary for their resolution.

Nonstationary Thermal Self-Action of a Partially-Coherent Laser Beam in a Turbulent Atmosphere

18600164f IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 31, No 11, Nov 89 pp 1409-1412

[Article by V. A. Banakh, I. N. Smalikho, A. V. Taylakov]

[Abstract] This study analyzes nonstationary thermal defocusing and the wind refraction of a partially coherent laser beam from turbulent air mixing. The analysis assumes that heat transport is largely determined by air turbulence while the transverse components of the wind velocity vector follow a normal distribution. The analysis suggests that the beam width and wind refraction levels, as in the case of a homogeneous medium, vary nonmonotonically in time. It is also demonstrated that the substantial change in the diffraction conditions at the radiating aperture cause little variation in the size or magnitude of wind- induced beam refraction. The article also discusses the influence of the transverse wind velocity component on the nature of thermal beam self-action.

Electrodynamic Analysis of Nonstationary Processes in Thin Cylindrical Antennas with Nonlinear Loads

18600166a RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 33, No 12, Dec 88 pp 2471-2482

[Article by A. N. Yegorov, V. Ye. Ryabtsev]

[Abstract] This study is devoted to numerical modeling of a thin cylindrical antenna over a screen with a nonlinear load connected directly to its terminals and to an investigation of the regularities of critical operating conditions of the semiconductor diodes based on a sample rectenna element in the form of a dipole with a bridge-type rectifier circuit. Such a circuit accounts for the most characteristic types of nonlinearities in a Schottky diode including those of a reactive type; this example is used to numerically investigate critical operating conditions that can lead to diode failure. Analysis of the relations provided for the transient processes in the rectenna demonstrate that, first, in nominal loading conditions of the rectenna, even with sudden application of the excitation field, no critical situations that would facilitate diode failure are observed. Second, the critical condition that is most dangerous for diodes in a rectenna occurs from an emergency loss of rectenna load in normal operating conditions or when no load is present and the field is applied. In this case the reverse voltage across the diode rises by a factor of two and approaches the no- load voltage at the antenna output, while an avalanche breakdown may occur for diodes with a low breakdown voltage; as a rule this is accompanied by a many-fold rise in thermal losses across the junction and may cause both overheating and failure of the diode junction.

The Discrete Source Method for Diffraction Problems by a Body of Rotation in a Dissipative Half-Space

18600166c RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 33, No 12, Dec 88 pp 2506-2514

[Article by Yu. A. Yremin, N. V. Orlov]

[Abstract] This study employs the discrete source technique to develop an algorithm to analyze electromagnetic

wave scattering by a body of revolution in a dissipative half-space. The algorithm is implemented as a program package for the BESM-6 computer; this package could be run efficiently on the computer and makes it possible to calculate the scattering characteristics in real time. Results are presented from a computer experiment to analyze the amplitude-frequency responses of the scattered field in order to establish the characteristics of the dielectric scatterer for the case of diffraction of a plane wave propagating along the axis of symmetry on an oblate dielectric ellipsoid with a semiaxis ratio of 3. The most valuable parameters that make it possible to establish the existence of characteristic indicators of a dielectric scatterer, making possible scatterer identification, are determined. The analysis suggests that the most important characteristic is the amplitude-frequency response of the anomalous field.

Time-Pulse Method of Near-Field Antenna Parameter Analysis

18600180c IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 32, No 1, Jan 89 pp 73-83

[Article by S. V. Goryunova, S. V. Drozhilikin, V. N. Zhavoronkov, D. M. Monomarev, L. R. Semenova, S. P. Skulkin, V. I. Turchin

[Abstract] This article discusses a method of determining an antenna directional pattern by measuring the near-field space-time relation of an antenna field produced by a video pulse signal followed by conversion of the measured data. In order to use the time-pulse method in the near field this study develops techniques for converting the time dependences of signals measured in the near field into the same dependences in the far field as well as techniques for determining the characteristic signal delays in the near field primarily to estimate the possibility of the rejection of signals scattered by surrounding objects and, finally, the article tests the technique on a reflector antenna 7 mm in diameter operating at a central frequency of 1.7 GHz. Measurement data processing algorithms are provided and the requirements on the measurement technique are discussed. The measurement results indicate that the time-pulse method of determining the near field directional pattern for a rather highly directional test antenna can be implemented using standard measurement instrumentation; the measurement results were in qualitative agreement with theoretical estimates of the time dependences of signals from aperture antennas in the near field.

Low-Frequency Whistler Propagation in the Ionosphere

18600173a IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31, No 11, Dec 89 pp 1423-1430

[Article by V. A. Mazur]

[Abstract] This study investigates the influence of ordinary Joulian dissipation on the propagation along the terrestrial surface of an electromagnetic wave of frequency below the ion gyrofrequency. This wave appears as a whistler (whistler mode) in the ionospheric Hall layer. The study demonstrates that dissipation due to the Pedersen ionospheric conductivity is fundamentally responsible for influencing radiowave propagation; in fact such conductivity is so great that it essentially prevents propagation of a low-frequency whistler along the terrestrial surface. The physical picture behind this circumstance is quite simple. The wave "carrier" by which a low-frequency whistler can propagate is a layer of high Hall conductivity. However, it borders on (and even interacts) with the Pedersen conductivity layer. The characteristic values of the Hall and Pedersen conductivities and the layer thicknesses are of the same magnitude. Hence, the real and imaginary frequencies are generally of the same order.

Comparison of Experimental Data to Numerical Modeling of Polarization Effects From Wave Backscattering by a Meteor Trail

18600173b IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31, No 11, Dec 89 pp 1431-1436

[Article by V. A. Permyakov, V. V. Sidorov, R. G. Khuzyashev]

[Abstract] This study investigates the polarization relation of the amplitudes and difference phase of signals reflected by a meteor trail and received by crossed antennas. The calculation model in the present study is reduced to determining the amplitude and phase of signals scattered by the meteor trail and received by linearly polarized crossed antennas. The study focuses on the behavioral dynamics of the difference phase resulting from antenna rotation with respect to the axis of the meteor trail. It is demonstrated that within experimental error the change in the difference phase is due to wave scattering by underdense trails whose resonant phase range is concealed by the initial radius or by the proximity of the electrical vector of the incident, linearly- polarized wave to the longitudinal or transverse (with respect to the trail axis) directions causing the crossed antennas to receive scattered waves of the same polarization with identical phase characteristics yet different amplitudes. The study concludes that the explanation provided for experimental data based on a comparatively simple longitudinal homogeneous electrodynamic model of a meteor trail is quite satisfactory and eliminates the necessity of considering more complex models of meteor trails.

Beam Shaping from Whispering Gallery Wave Diffraction by a Convex Cylindrical Surface

18600173d IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31, No 11, Dec 89 pp 1482-1487

[Article by S. N. Vlasov, M. A. Shapiro, Ye. V. Sheynina]

[Abstract] This study investigates the shaping of a wave beam by whispering gallery wave diffraction on convex surfaces which does not disrupt the ray picture of the radiation at the edges nor does it interfere with the production of side lobes. The ray coordinate system more closely corresponds to such a formulation of the problem. The analysis reveals that a bell-shaped field structure results from the radiation of a whispering gallery wave from a convex surface over a distance of the order of the Fresnel length: the primary radiation in the form of a Gaussian beam with phase aberrations and low level lateral radiation. It is also determined that the greatest amplitude distortions to the beam in the far field occur when τ is approximately equal to L/2.

Experimental Investigation of the Amplitude Characteristics of Signals Transmitted Through the Artificially Perturbed Lower Ionosphere

18600173e IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31, No 11, Dec 89 pp 1527-1531

[Article by V. A. Ivanov, Yu. A. Ignatev, V. A. Frolov, P. B. Shavin, V. V. Shumayev]

[Abstract] This study is devoted to an experimental investigation of the effect of artificial perturbation to the lower ionosphere induced by powerful decameter wavelength radiowaves on the amplitude characteristics of oblique imaging signals; this makes it possible to evaluate both certain parameters of the large-scale ionospheric perturbation and changes in its inhomogeneous structure. It is determined from the analysis that the large-scale perturbation region in the lower ionosphere with an elevated electron concentration will not only lead to a reduction but also an increase in the amplitude of imaging test signals depending on the geometry of the signal path. It is also established that when the lower ionosphere is heated in geophysical conditions there is an increase in the fluctuation frequency of the test signal which is due to the increasing electron concentration in existing natural inhomogeneities of scales greater than 200 m.

Double Modulation of Energy Flux in Reproducing Low-Frequency Signals in Multiphase Converters

18600112a Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 5, Sep-Oct 88 pp 34-42

[Article by G. Ya. Mikhalchenko]

[Abstract] This article develops a technique for double modulation of the energy flux in a multiphase network and applies such modulation in pulse- modulated converters. The study derives several expressions and output voltage curves to explain the essence of double modulation and these also provide a clear illustration of the design principles underlying the development of compensated converters. The double modulation algorithms obtained in the study can implement internal interphase swapping networks for the reactive load energy, thereby eliminating reactive currents from the supply network. It is also demonstrated that double-modulation multiphase systems do not produce intermodulation distortion current harmonics from signals at the frequency of the modulating interference.

Dynamic Error Analysis for a Digital Frequency Multiplier

18600112b Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 5, Sep-Oct 88 pp 81-87

[Article by N. A. Rudenko, V. Ye. Efremov]

[Abstract] This study carries out an analysis of the dynamic error of digital frequency multipliers used in power transmission equipment. The study derives formulae for calculating the frequency multiplier requirements. It is determined that measurement error grows with increasing harmonic number. The study provides a frequency multiplier design that produces multiplication factors of the order of several thousand and is useful for operation over a broad frequency range. This study also analyzes the dynamic error of the proposed digital frequency multiplier. This frequency multiplier can be used in power generator monitoring equipment and, even in fault conditions of the power generating system, has a low dynamic error, which makes it promising for use in measuring power parameters.

Dynamic Error of a Selective Amplifier-Based Phase-Storage Device

18600112c Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 5, Sep-Oct 88 pp 87-91

[Article by I. A. Ornatskiy, V. Ye. Sidorchuk]

[Abstract] This study analyzes the dynamic error in a phase-storage device based on tuned circuits. In this design a square-wave RF pulse containing several carrier frequency cycles is injected to the front-end amplifier. The input signal is strobbed by a gate to improve noise immunity. In order to improve measurement accuracy the decaying oscillations present at the output of the selective amplifier are downconverted by means of a mixer. One additional phase memory is required since rapidly diminishing sinusoidal oscillations are present at the mixer output, and this design uses a more complex strobing circuit consisting of two gates that carry out scaling of the amplifier and the adder. This study derives formulae for calculating the dynamic error and other performance factors of this phase-storage device. The phase measurement error for the circuit with a single gate and an exponential input signal is approximately 13°. This calculation was carried out for circuit parameters corresponding to the phase meter prototype. The design modifications used in this phase meter were successful in reducing the phase shift measurement error attributable to changes in strobing time (the initial phase of the output signal) to 0.1° when averaging over 100 measurements.

Effect of Structural Inhomogeneity of an Ultrasonic Converter on its Amplitude-Frequency Response

18600113d Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 33, No 11, Nov 88 pp 2290-2296

[Article by M. P. Bakhturin, V. M. Levin]

[Abstract] This article carries out a theoretical analysis of the effect of an inhomogeneous distribution of the density and elasticity moduli of an ultrasonic converter on its amplitude-frequency response. This study employs geometric acoustics to calculate the amplitude-frequency response of the converter in the high frequency range where the convert thickness is greater than the acoustic wavelength and obtains the amplitude-frequency response for random distributions of the acoustic and piezoelectric properties in the converter cross-section. The study also considers sample amplitude-frequency responses for a converter with a variable density, modulus of elasticity, and piezoelectric modulus. It is determined that a linear distribution of a piezoelectric modulus or a linear distribution of the induction represent the optimum design for fabricating a broadband converter. It is also determined that a converter whose broadband performance can be attributed to preferential free boundary radiation has twice the amplitude efficiency of a converter with preferential boundary radiation through an acoustic line.

Analysis of the Fundamental Structure of Slotted Dielectric Integrated Circuits

18600113g Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 33, No 11, Nov 88 pp 2373-2381

[Article by S. E. Bankov, V. V. Vzyatyshev]

[Abstract] This study Carries out an investigation of the interaction of electromagnetic fields at the interface of two waveguides. This makes it possible to establish the

nature of the primary phenomena occurring in integrated circuits based on dielectric slotted waveguides. The analysis involves derivation of an analytic expression for the reflection coefficient and its dependence on the longitudinal wave number. It is demonstrated that the input impedance with certain angles of incidence vanishes as is the case with the energy stored near sharp metallization edges. This study identified surface waves localized near the boundary of the semiinfinite regions and determined that the boundary resonance and boundary waves have a significant influence on the fundamental mode in a dielectric slotted waveguide.

Analytic Analysis of Surface Acoustical Wave Filters

18600113h Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 33, No 11, Nov 88 pp 2395-2399

[Article by Yu. V. Gulyaev, Ya. I. Lepikh]

[Abstract] This study proposes a method of analyzing the influence of topology error in interdigital converters on surface acoustical wave filter performance; this allows analytic determination of the distribution law of the amplitude-frequency response; it is demonstrated that the analytic method can also be used to strictly determine the statistical properties of surface acoustical wave filters. The analysis focuses on a classic surface acoustical wave filter design with the radiating and detecting interdigital converters located in a common acoustic channel; one of the converters is apodized, while the second is nonapodized and is a rather broadband converter. The analysis employs a mathematical model with two δ-functions to analyze interdigital converter performance. A comparative analysis of results obtained from using the proposed analytic method and the Monte Carlo technique demonstrated that the calculation results were identical, although the run time on an ES-1033 computer was less than 1 minute for the analytic method and was more than 55 minutes for the Monte Carlo method. It is then determined that the proposed technique of investigating surface acoustical wave filter performance is more efficient.

Numerical-Analytic Computer Modeling of Nonlinear Radioelectronic Circuits

18600115a Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31, No 9, Sep 88 pp 3-8

[Article by A. A. Molchanov, I. F. Zinchenko]

[Abstract] This study examines a method of implementing numerical-analytic modeling of nonlinear objects in a computer-aided design system by introducing differential equation sets into their functional descriptions. A first order polytypc logic formalism is used for this purpose. In this application the functional descriptions are simplified by reducing the system of differential equations to normal form. An analytic solution of the system of differential equations is derived using Lie series. It is determined from the application of this system that numerical-analytical modeling of electronic circuits that involves introducing differential equation sets (with a small parameter) into their mathematical models is one method of improving the intelligence level and expanding the functional capabilities of the modeling subsystems in computer aided design systems.

Composite Logic-Electrical Network Modeling Algorithms

18600115b Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31, No 9, Sep 88 pp 8-13

[Article by V. L. Kogan]

[Abstract] This article analyzes a generalized logic-electrical network model and the composite modeling algorithms developed on the basis of this model. The analysis considers three different algorithm variants: one where the logic models are given priority, one where the circuit engineering models are given priority and one where equal priority is given. It is demonstrated that the program implementation of circuit engineering models is substantially simplified in the algorithm with logic model priority. It is possible to develop simple, rather accurate and computer-efficient circuit-engineering models for the functional components in digital circuits. These models do not have electrical connections in the logic model environment and consequently can be calculated independently in each time step, i.e., it is possible to significantly increase the size of the problems solved. Therefore this algorithm, while conserving the speed of logic models, can be used to analyze continuous signal variation (transient processes) in digital circuits. It is advisable to use the logic model priority algorithm for designing digital very large scale integrated circuits. The overall advantage of logic-electrical modeling techniques lies in the reduction in calculation time both with respect to RAM memory and overall calculation time.

A Computer-Aided Design Methodology for VLSIC Microtopology Analysis

18600115c Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31 No 9, Sep 88 pp 24- 31

[Article by B. G. Konoplev, A. I. Astakhov]

[Abstract] This article analyzes logic element designs in three different integrated circuit fabrication technologies: integrated injection logic, MOS logic, and CMOS logic. The primary purpose of the methodology under analysis is to design a microtopology for VLSIC nodes and devices that reduces the design periods and provides a high chip area utility factor. The VLSIC devices

developed using this technology are more compact than those designed using the standard component groups; these VLSIC chips operate at a faster speed achieved primarily from a reduction in the length of interconnections. The computer-aided design subsystem was implemented on an SM-1420 computer. The VLSIC segments designed using this methodology have surface area and performance parameters comparable to those devices designed manually; on the average the use of the new methodology provided a 15-45 percent savings in area utilization.

Adaptive Method of Analyzing Nonlinear Narrowband Electronic Circuits

18600115d Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31 No 9, Sep 88 pp 44-50

[Article by S. L. Morugin]

[Abstract] This study performs a numerical analysis of transient and steady- state conditions in the case of a quasiperiodic multifrequency and pulsed action on narrowband circuits. Adaptable models are developed for the numerical analysis; these models adapt to the features of the input actions in both the spectral and temporal domains. The approach developed in this article to an abbreviated calculation of the transient processes makes it possible to analyze, with any degree of accuracy, the combined action of fast (pulsed) and slow quasiperiodic actions on both narrowband and broadband circuits and to determine steady-state quasiperiodic operating conditions.

Physical Modeling of Electronic Direction-Finding Systems

18600115e Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31, No 9, Sep 88 pp 57-58

[Article by N. A. Zatenko, O. T. Nikolov, M. V. Parkhomenko]

[Abstract] This article develops two laboratory prototypes of electronic direction finding receivers that make it possible to investigate the fundamental principles of designing such systems. The first receiver is based on separation of the normal and anomalous signals by virtue of their different polarization. The radiator is an electric dipole submerged in a vessel containing a salt water solution and fed from an acoustic generator. The receive section contains a current sensor, a matching transformer, and a low-noise preamplifier contained within a waterproof cassette and submerged in the vessel. A three-channel model that implements the approach described in this article is developed; this model contains all components necessary for detecting an electronic direction- finding signal in a single channel. The two additional channels are designed analogously. The sensors are in a plane perpendicular to the direction to the signal source. The system analysis revealed that within a closed water body external objects have only a weak influence on the distribution of electrical fields which makes it necessary to use special methods to detect anomalous signals. The complexity of tuning receivers to achieve maximum compensation of normal signals increases substantially when designing multichannel electronic direction finding detection and processing systems with multiple lateral connections required to improve image contrast; this necessitates system automation.

Voltage-to-Frequency Converter for an Analog Magnetometer

18600119a Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 88 pp 84-85

[Article by V. A. Bogdenko]

[Abstract] This study describes a voltage-to-frequency converter design that employs three identical channels to convert analog voltages from six magnetometer outputs into corresponding frequency-pulse sequences. Two monopolar voltages are alternately converted by a single converter channel so that during the measurement process each field component is represented by only one of the unipolar voltages which determine the field value and sign, while the other voltage is equal to zero during this period. The specifications of the converter include: number of conversion channels: 6; input voltage range: 0- 6 V; output frequency range: 0-2400 Hz; input pulse amplitude: 3 plus or minus 0.5 V into a 75 ohm load; output pulse polarity: positive; output pulse duration: 4 plus or minus 2 mcs; conversion accuracy: 0.5 percent.

Nanosecond High-Attenuation Microwave Switch

18600119b Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 88 pp 86-88

[Article by A. R. Robert Korsunov, A. M. Tishenko, V. T. Tsarenko]

[Abstract] This study reports the development of a four-stage microwave switch employing a four-channel submodulator employing charge storage diodes with independent output pulse control in each channel. Silicon diode p^+-n-n^+ structures housed in metalloceramic packages are used as the microwave signal switching elements. These structures have the following parameters: capacitance: .06-0.8 pf; differential resistance for a forward current of 5 mA: 3-5 ohms; layer thickness: 2-5 mcm; and switching time at 5 mA and a bias voltage of 5 V: 0.5 ns. This four-stage microwave switch had initial loss levels of .5 to .7 dB in a 15 percent frequency range with an attenuation level of -50 dB and an attenuation nonuniformity of plus or minus .7 dB in a 15 percent frequency range. The submodulator was fabricated on a glass textolite printed circuit board with the normal surface mounting of components. The entire unit is powered by a 5 V power supply. The switching time of

the four-stage microwave switch is less than 1 ns with the microwave signal modulation pulse duration variable over the range 2-10 ns.

Nine-Pole Complex Reflection Coefficient Meter for Nonlinear SHF Devices in Interference Conditions

18600119c Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 88 pp 89-93

[Article by A. N. Zaytsev, V. B. Kulikov, V. I. Pyatayev]

[Abstract] This study describes a ten-pole meter that is used to measure the modulus and phase of the complex reflection coefficient of linear and nonlinear, active and passive microwave devices in a standard 50-ohm coaxial 7/3 mm in cross-sections in the following interface conditions: in the presence of upper order harmonics generated by the nonlinear device itself or in the event of noncoherent oscillations with a continuous or discrete spectrum. The complex reflection coefficient is measured indirectly by recording the sum powers of two linear combinations of incident and reflected waves and a coherent harmonic reference signal. The primary meter specifications are as follows: frequency range: 2-5 GHz; power range: 1-200 mW; complex reflection coefficient measurement range, modulus: 0.1-1.0, phase: 0-360°, respective measurement errors: .01 and plus or minus 5°.

Results from Line Tests and the Experimental Operation of the IKM-480S (German Democratic Republic) Line Circuit Equipment in the USSR

18600126a in Russian No 1, Jan 89 pp 6-10

[Article by M. Brandes, L. Vons, D. Fligner, V. G. Shulga, V. D. Shcherbakov, L. F. Rasporkin, V. E. Gurevich, A. A. Zhilchik]

[Abstract] This study reports the design, configuration and performance of the IKM-480S equipment installed in the USSR (an experimental line in the Byelorussian SSSR). The equipment delivered to the USSR will be used to reconstruct long-distance communications lines on four-quad HF balanced cables with a 1.2 mm conductor diameter equipped with K-60P automatic transmission systems. The maximum length of a single line circuit in the IKH- 480S system is 2500 km. This study also reports the system performance specifications, installation configurations, and line tests on this system and modifications made to the equipment resulting from the line tests and experimental operation. Line tests and experimental operation of two IKM-40S line circuits on the test line in the USSR revealed that the IKM-480S system has excellent performance characteristics and can generate between 480 and 3840 voice grade frequency channels in a four-quad HF balanced cable. It is also possible to use the free pairs of other quads for the K-60P transmission system and to gradually replace the K-60P equipment with the IKM-480S equipment without substantial capital investment on reconstruction stages.

Results from Error Coefficient Analysis of the IKM-480S Line Circuit

18600126b ELEKTROSVYAZ in Russian No 1, Jan 89 pp 10- 13

[Article by S. V. Dulov, Ye. Ya. Durets, A. Ye. Nazimok, K. A. Nepomnyashchiy, Yu. K. Smirnov]

[Abstract] This study reports a technique for experimental investigation of the error coefficient for the IKM-480S line circuit together with associated experimental results. Automated test instrumentation based on the "Elektronika D3-28" was used for these error coefficient measurements. The microcomputer performs initial setting of the multichannel pulse counter and then alternately interrogates the channels in a program-set time sequence and also collects measurement results and performs statistical processing. Two techniques were used to monitor digital error flows in the line circuits: 1) a GK5-83 generator was used for character comparison of the transmitted pseudorandom sequence to the sequence at the output of the line circuit and 2) by using the error detector which is a component part of the terminal line circuit bay to determine the number of structural faults in the 5V6V code. The following data were printed out as experimental results: measurement session number, the number of errors identified from the character comparison, the number of errors identified from code structural variations, error coefficient estimates based on the character comparison, and error coefficient estimates based on code structural changes, and information on session duration. The line tests revealed that the error coefficient on a line circuit section 64 km long and including 22 regenerators lies in the range .8 times 10^{-11} with a confidence probability of .954; the corresponding error coefficient for a single regenerator is between 3.6 times 10^{-12} and 1.09 times 10^{-12}. The study also determines that the highest error coefficients were observed at the beginning of the experimental test period and that the error detector employed in the IKM- 480S line circuit subscriber bay identified up to 25% of the faults.

Color Vision Adaptation Model. Part 1: Photochemistry and Analog Electrical Signals

18600141a TEKHNIKA KINO I TELEVIDENIYA in Russian No 2, Feb 89 pp 3-13

[Article by L. F. Artyushin]

[Abstract] This study develops a new human color vision adaptation model based on research that suggests that visual perception vanishes when images are blocked from moving across the retina. The present analysis focuses on tremor modulation of radiant flux in the retina which produces square-law coding of the color and color-difference signals of the perceived color images. This study proposes that visual perception be expressed not by the receptor response but rather by the relative increment in the response over the tremor half-cycle which characterizes the radiation-induced change in the

concentric shape of the pupil. It is also determined that each of the three characteristic response curves of the cone receptors is determined by the product of the contrast factor and the logarithm of the actinic flux present during the tremor half-cycle. The Helmholtz complete linear element which explains the adaptability of the human visual system to illumination conditions is also modified and substantiated. This is used as the basis for formulating the analytic model of human color vision allowing a quantitative estimation of color perception processes. Finally the study determines that color coding in the visual system results from the lag of the decoloring process in the visual receptors causing visual information to be generated by the square-law modulated electrical signals.

Comparative Analysis of the Spectral Characteristics of Information Signals from Diffraction Measurement Standards

18600131a Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 32 No 5, Jan 89 pp 70-74

[Article by A. S. Mitrofanov, V. N. Poyarkov]

[Abstract] This study carries out a comparative analysis of the spectral characteristics of information signals from diffraction measurement standards obtained from scanning various sections of a diffraction pattern and from scanning a pattern with an equalized amplitude of the diffraction maxima. Various formulae are derived for determining the spectral widths of the signals in different operating conditions. Calculations were carried out for a signal obtained by scanning from the point at which the jump in signal amplitude is equal to its amplitude at the first diffraction maximum and for a signal obtained by scanning from the point corresponding to the first diffraction minimum. It is determined that the latter signal, which has the shortest spectral width, is the optimum signal. The analysis suggests that the signal obtained from scanning the diffraction distribution with an equalized amplitude of the diffraction maxima can be useful. These results help to make a properly- substantiated selection of the analyzed portion of the diffraction distribution in designing laser diffraction measurement standards, for substantiating the equalization of the amplitudes of the diffraction maxima, and for determining the bandwidth requirements on the electronic circuits in measurement standards.

The Frequency Responses of an Acousto-optoelectronic Signal Detector for a Solar Radio Interferometer

18600131b Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 32 No 5, Jan 89 pp 75-79

[Article by I. I. Sayenko, V. Ya. Komar, M. I. Mansyrev, S. A. Molodyakov]

[Abstract] This study analyzes the development of the frequency responses of separate channels in an acousto-optoelectronic detector. For application in a solar radio interferometer. The spectrum of the RF noise signal collected by the radio telescope is converted by the frequency converter into an IF frequency range. After amplification the signal is sent to the acoustooptic modulator. A portion of the collimated optical beam, after diffraction by the acoustic wave, passes through the acoustooptic modulator and generates an "image" in the focal plane of the Fourier objective where the intensity distribution along the coordinate ξ is proportional to the distribution of the spectral power density of the acoustooptic modulator input signal. This study analyzes the formation of the channels in such a detector and their frequency responses. The derived relations suggest that the maximum bandwidth ratio at -20 and -3 dB does not exceed 1.25 for m is greater than or equal to 4 while the maximum oscillations in the frequency response of the channel due to insensitivity regions in the charge coupled elements of the photodetector do not exceed 10 percent. The derived frequency responses of several neighboring channels for various summation moduli are also provided. The measured characteristics are in good agreement with the calculated characteristics. The study emphasizes that the measured frequency responses of the various channels are near-identical.

Direction Finder Model for a Laser-Information System

18600131c Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 32 No 5, Jan 89 pp 79-84

[Article by A. V. Demin, I. A. Lapshina]

[Abstract] This study considers the stages involved in modeling a direction finder for laser bidirectional target tracking systems with conical directional pattern scanning. This study employs modular modeling where each element in the structure is assigned a block in the algorithm. A set of functional element models for the structure is then obtained and is used for developing various configurations of the modeled systems and its component parts. The functional elements are then used to construct an algorithm for the direction finder model with conical direction pattern scanning and for analog processing of the information signal. The proposed direction finder model, as a part of the entire system model, can be used to synthesize and analyze both the entire system and its separate components. The algorithm can be used for calculating the direction-finding characteristics of laser-information systems.

Investigation and Optimization of Non-Force-Cooled Frequency Lasers Based on Gd-Sc-Ga Garnet:Cr:Nd

18600131d Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 32 No 5, Jan 89 pp 88-92

[Article by V. A. Berenberg, G. N. Dulnev, A. Ye. Mikhaylov, V. G. Parfenov]

[Abstract] This study analyzes the effect of thermal operating conditions on the properties of naturally-cooled Gd-Sc-Ga garnet:Cr:Nd crystal lasers and evaluates the

effectiveness of various methods of improving their temperature stability. The analysis focuses on a single-lamp pump system with a diffuse reflective coating and an active element in a leucosapphire tube. The effect of such factors as the dimensions of the reflector cavity, the interaxial distance between the lamp and active element, pump tube thickness, the use of coatings on the tube surface that selectively reflect thermal radiation, variations in the chromium ion concentration in the active medium, etc, on the efficiency of the pump system, thermooptic aberrations in the active element, and the output energy decay due to temperature variations in the spectroscopic parameters of the active medium. It is determined that the pump energy absorbed in an active element based on Gd-Sc-Ga garnet:Cr:Nd significantly exceeds the radiation energy absorbed in a YAG active element. The temperature field in the former case therefore is influenced by internal heat production and the relative contribution of heat influx from the heated pump tube is significantly less than in the case of a YAG element. It is determined that this is responsible for the substantial difference in the nature of thermal aberrations. It is also determined that one of the causes of significant internal heat production in the Gd-Sc-Ga garnet:Cr:Nd active element is the broad absorption bands of the chromium ions. Proper selection of the chromium ion concentrations can therefore substantially reduce thermal aberrations and improve laser performance.

Analog Signal Transmission by two Types of Overlapping Pulses

18600139a Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 31, No 11, Nov 88 pp 7-11

[Article by L. M. Trubitsyn]

[Abstract]In order to eliminate the significant influence of noise on decoding this study proposes employing two types of overlapping pulses for analog signal transmission; this technique also reduces the necessary signal measurement accuracy on the receive side. Two different pulses are used to transmit the bit zeros and units. The only difference between the pulses is the value of the angular frequency. Analysis reveals that this technique eliminates the distorting influence of noise on the decoding result and also reduces the necessary parameter measurement accuracy on the receive side since the level of precision required diminishes when two pulses are employed. The implementation of this technique, however, requires approximately twice the equipment of the single-pulse technique due to the need to store and transmit the ordinates of two rather than one pulse.

Magnetic Amplifier in the Magnetization Channel of an Ultrasonic Generator

18600139b Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 31, No 11, Nov 88 pp 54-60

[Article by B. P. Ryazanov, A. O. Shiryayev, Z. I. Ryazonova]

[Abstract] This article considers the application of a magnetic amplifier as a stabilizer for bias current stabilization and for producing modulated ultrasonic oscillations through a stabilizer design as a self-excited oscillator. This stabilizer is used in the magnetization channel of an ultrasonic generator and consists of a comparator based on an amplifier, repeater, magnetic amplifier, a rectifier, a first filter, a shunt, a second filter, a matching divider, and a magnetostriction converter. When functioning as an amplifier the stabilizer performs pulse-frequency modulation of the input signal with a period of T/2 and therefore delays data transmission between ¼ and ½ of the cycle. A simple switch can be used to convert the stabilizer to a self-excited state. The study achieves results sufficient to understand the operating principles of the stabilizer. Calculation and experiment were in agreement with respect to stabilizer stability within the current control range from .5 to 6 A and also with respect to the capability to switch the stabilizer to a self-excited condition while maintaining control over the average current value within this same range.

The Influence of Background Light on the Precision of Atmospheric Scattering Measurement Systems Generator

18600139c Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 31, No 11, Nov 88 pp 68-73

[Article by R. R. Agishev]

[Abstract] This article analyzes the influence of background light on the accuracy of a scattering indicatrix meter. The one aspect that differentiates this technique from the traditional method is the use of a second (reference) receive channel whose optical axis is orthogonal to the scattering plane and passes through the point of intersection of the probe rays. Such an indicatrix meter design made it possible to substantially reduce measurement error caused by the anisotropy of the optical density of the test media. The study analyzes the scattering conditions and assumes that the transmission factor of the optics and the quality of the filters are identical for both detectors and subsequently determines the relative measurement error of the scattering indicatrix produced by background illumination. Calculations of the measurement error due to background illumination and alignment error are also provided. The study determines that there exists certain angles of the field of view where the resulting measurement error is minimized. It is also clear that proper selection of optimum parameters of the optical systems of the indicatrix meter can assure that substantial variations in background brightness will not play a significant role.

Method of Calculating the Signal-to-Noise Ratio for an Image Converter Scattering Measurement Systems Generator

18600139d Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
Vol 31, No 11, Nov 88 pp 73-77

[Article by S. P. Avdeyev, Ye. V. Gritskevich]

[Abstract] This article discusses a method of calculating the signal-to-noise ratio for an on-screen image in an image converter. The image converter is considered to be an intermediate element in an electrooptic circuit, i.e., its image undergoes further conversion by, for example, an array CCD- photodetector. The analysis considers such noise sources as photon fluctuations, Schottky noise attributable to electrons emitted by the photocathode upon impact of the incident radiation as well as the electron flux producing the dark current and photon fluctuations produced by the image converter screen. The study then derives relations that make it possible to determine the values of the noise and signal components based on the image converter specifications. All components entering into the signal-to-noise ratio are determined by both the image converter specifications and the properties of the image projected onto the photocathode. This technique can therefore be used in both engineering calculations and for computer modeling of image converter display devices.

Fiber-Optic Acoustic Field Tomography

18600164e IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31, No 11, Nov 89 pp 1388-1393

[Article by A. I. Malekhanov]

[Abstract] This article discusses various possibilities for application of fiber-optic transducers to tomographic recovery of acoustic field distributions. The article focuses on the problem of determining the position of a cylindrical acoustic wave radiator and considers as one possible application the deep-water acoustic research program aimed at recording cosmic muons and neutrinos (the Dumand project). The fiber-optic tomographic design is discussed. In this configuration each element is a transducer of linear configuration. The detection optical fibers lie in a common plane forming a rectangular lattice. In this case the isolines are concentric ellipses or circles if the radiator axis intersects the array plane at a right angle. This method of determining the position of a source is based on the extrapolation of the dependence of the recorded signal phases on the position of the optical fiber detectors in the array. The study also provides an estimate of the ultimate sensitivity of fiber-optic tomography for application to a Dumand-type experiment.

Optimum Filtering Algorithm for Filtering a Legitimate Signal Against a Background of Multipath Nonstationary Concentration Interference

18600169b IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 31 No 12, Dec 88 pp 8-12

[Article by V. B. Fortes, V. A. Laktinov]

[Abstract] This study derives an optimum transfer function of a receiver that produces a maximum power ratio of the fixed and random signal components assuming that the delay spectrum of the fluctuating signal component at the input is concentrated near the arrival time of the determinate signal component. The transfer function in the general case will depend on the statistics of the radiowave propagation channel and the signal type. In the case of relatively broadband signals whose bandwidth is much greater than the "bandwidth" of the channel detailed knowledge of the complex signal spectrum is sufficient to synthesize an optimum filter. It is demonstrated that an analogous method can be used to solve the problem of optimum signal filtering against a background of quasi-nonstationary interference concentrated on the time and frequency axes and appearing simultaneously with the legitimate signal. The results of this study can be used to optimize broadband communications systems and other systems where the signal is present against a background of multipath or nonstationary concentrated interference.

Linearity of Diode Cut-Off Charge Injection to Surface-Channel Charge- Coupled Devices

18600169d IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 31 No 12, Dec 88 pp 37-40

[Article by V. V. Gubarev, A. I. Krymskiy, Kh. I. Klyaus, V. V. Olshanetskaya, Ye. I. Cherepov, I. M. Shmerlin]

[Abstract] This study is devoted to a detailed investigation of the linearity of charge injection to surface-channel charge-coupled devices by the diode cut- off technique. The injection device consists of an input diode and two gates. A fixed back voltage is injected to the diode while a pulsed depletion voltage is injected to gate 1 and the information voltage is injected to gate 2. The resulting charge packet following the end of the first pulse is sent to the shift register by injecting voltage φ_1 to the first transmitting gate. The analysis reveals that for the gate sizes examined in this article (l_1 equals 10 mcm and l_2 equals 35 mcm) and at sampling times below approximately 300 ns the amount of charge that does not reach equilibrium grows with diminishing time which will cause output signal distortion. At sampling times of greater than 300 ns the higher frequency signals will be suppressed by the input device and hence their contribution to output signal distortion can be minimized. The data derived in the analysis suggest that if the first and second gates are fabricated at lengths of 5 mcm and 10

mcm respectively, which is technically simple, it is possible to implement an upper order harmonic level of the order of minus 60 dB at sampling durations of 35- 50 ns for p-channel surface CCDs and 10-15 ns for n-channel surface CCDs. Optimum substrate doping levels must be selected in order to achieve these parameters in the CCDs.

Optimum Scaling of Bipolar Transistor Structures and Interelement Connections for Silicon VLSICs Background of Multipath Nonstationary Concentration Interference

18600169c IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31 No 12, Dec 88 pp 31-37

[Article by A N. Bubennikov]

[Abstract] This study considers the primary design principles and selection of optimum scaling algorithms for submicron transistor structures and interelement connections for present and future VSLICs. Relations are derived to demonstrate the fundamental possibility of achieving the necessary relation for greater horizontal reduction in size of logic elements compared to vertical dimensions in order to satisfy a compromise between the maximum integration scale and the logic element operating speed in VSLICs. One expression demonstrates the possibility of balancing a useful reduction in the level of logic element electrical parameters with a minimum duty factor and optimum current levels for achieving maximum performance. It is demonstrated that the most effective techniques for increasing the system speed of logic elements is to use new circuit engineering designs of output complementary stages - voltage switchers - in conjunction with serial partitioning of the logic circuits to reduce signal transmission delay between the base logic circuits. Optimum scaling of bipolar transistor structures and logic elements examined in this article make it possible to use coordinated reduction in horizontal and vertical dimensions of integrated elements as well as partitioning of logic circuits (depending on operating speeds, and circuit integration scales) to achieve high-quality design and development of VLSICs in conjunction with a progressive reduction in the lithographic component size and chip dimensions.

Two-Dimensional Fourier Processing by Surface Acoustical Waves

18600169e IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31 No 12, Dec 88 pp 46-48

[Article by Yu. F. Zenkovskiy, A. Yu. Mikhatskiy]

[Abstract] This study focuses on Fourier processing of two-dimensional images formed as a surface acoustical wave field on the surface of an acoustic line. The oscillation amplitude is the information parameter of the two- dimensional surface acoustical wave field. Unlike optical devices the information SAW component propagates parallel to its plane and hence the Fourier transform of the component cannot be obtained simultaneously at all points. This analysis assumes that the SAW component travels in the XOZ plane along the OZ axis and one-dimensional Fourier transforms are carried out successively along the OX, OZ axes or vice versa. The sequence of the Fourier transforms on the axes is determined to minimize conversion error from parasitic effects associated with diffraction, the finite size of the processed field component, and the nonideal nature of the processed elements. Isolating discrete samples on the OX, OZ axes by using a finite number of field radiators and detectors as well as isolated dispersion delay lines reduces diffraction distortions. The study notes that it is possible to use surface acoustical wave devices to obtain the Fourier transforms running along the OX axis rather than an acoustoelectronic objective in order to produce a multipath directional pattern of the arrays at which the discrete components of the spatial SAW spectrum are detected and recorded.

Formation of Polarized Superbroadband Signals

18600169f IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31, No 12, Dec 88 pp 51-52

[Article by V. A. Sarychev]

[Abstract] This study focuses on a theoretical analysis of superbroadband signals and the design of a system for generating such signals. It is demonstrated that the functions derived in the study contain components in their spectrum that are identically elliptically polarized, i.e., having the same ellipticity factor or angle. A correlation of orientation angles of the polarized ellipse in all spectral components is achieved if the initial signal contains solely cosine or sine components. These properties of the derived complex functions make it possible to treat such functions as elliptically polarized oscillations with a given temporal structure. The study also provides a prototype design of a polarized superbroadband signal generator that produces such signals without altering the temporal structure of the initial linearly-polarized signal. This device consists of a Hilbert conjugation filter, a fixed number multiplier, an adder, a linearly polarized antenna, and an orthogonal linearly polarized antenna. It is demonstrated that it is possible to produce radiation of any polarization for a given temporal wave structure by varying the real multipliers a, b, c, and d.

Clock Synchronization Accuracy of Coherently-Generated FSK RF Signals

18600169g IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31 No 12, Dec 88 pp 58-60

[Article by S. A. Galun, T. A. Zhukovskaya]

[Abstract] This study investigates the possibility of developing a maximum likelihood-optimum clock synchronization device for clock synchronization of

coherently-generated RF signals received against a background of Gaussian noise and estimates its potential attainable noise immunity. The analysis focuses on frequency shift-keyed RF signals with phase continuity. An appropriate adaptive algorithm for estimating FM signal delay is also developed; an important advantage of the algorithm derived in this study is the invariance of its structure to the signal amplitude and the spectral density of additive noise which depend on many uncontrollable factors influencing reception. The article provides a prototype design of a device implementing this algorithm; this device measures the time delay of an FM radio signal with phase continuity and consists of harmonic generators, a 180 degree phase inverter, and a decision unit.

Frequency Transforms for Bandpass Filters with Arithmetically Symmetrical Amplitude-Frequency Responses

18600169h IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31 No 12, Dec 88 pp 69-71

[Article by I. V. Gurevich, I. S. Kislyakov]

[Abstract] This study derives a frequency transform to convert the amplitude-frequency response of a low-frequency filter into an attainable response of a bandpass filter satisfying arithmetic symmetry within sufficient proximity to the central filter frequency. In order to obtain an amplitude- frequency response that is symmetrical with respect to the central frequency and at the same time is attainable the study approximates the function $f(\omega)$ equals (ω minus $1)^2$ by four rational functions. The analysis requires that the functions $f(\omega)$, $F(\omega)$ and the maximum number of their derivatives coincide. These formulae are used as the basis for deriving new transforms that are subsequently employed for designing bandpass filters with amplitude-frequency responses that are as smooth as possible and are arithmetically symmetrical in the vicinity of the central frequency. The study also notes that the right halves of these expressions are not positive real functions and hence the parameters of the LC circuit of the bandpass filters cannot be calculated by simple modification of the components of the LF prototype as is normally done when using a reactance transform.

A Digital Signal Measurement, Calibration, and Correction Technique

18600170a Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 1, Jan 89 pp 10-11

[Article by A. D. Zoryev]

[Abstract] This article discusses an analog-to-digital converter with input gain together with a new digital calibration and correction technique. The proposed correction and calibration technique eliminates the reference standards, and replaces the piecewise linear approximation and interpolation by functional converters of the distorted characteristic; this serves to improve operating speed. This calibration technique also makes it possible to reduce measurement error from .1 to .05 dB and to both simplify and speed up the correction process.

Expanding the Dynamic Range of Nonlinear Distortion Meters by Means of Passive Rejection Filters

18600170b Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 1, Jan 89 pp 55-57

[Article by I. A. Teshev]

[Abstract] This article examines a method of measuring low harmonic coefficients that is free of the many drawbacks of existing techniques. The device that implements this method consists of two identical passive rejection filters from an GZ-118 oscillator. The filters are in a double T circuit configuration and produce attenuation of at least 40 dB at .02, .06, .12, .2, 1, 2, 10, 20, 100, and 200 kHz. The device also includes a three-position switch, and an S6-11 nonlinear distortion meter used for automatic measurements of the harmonic coefficient and to measure the RMS a.c. voltage. In order to determine the harmonic coefficient of a test signal using this technique it is necessary to perform five measurements using the S6-11 nonlinear distortion meter in an automatic mode and to then adjust the appropriate filter to suppress the first signal harmonic. Compared to previous techniques which employ a spectrum analyzer and a rejection filter at its input this technique employing a nonlinear distortion meter in a similar configuration makes it possible to improve the productivity of the testing routines by reducing the number of measurements and calculation operations.

Electrodynamic Calculation of Regular Screened Slotted and Multiconductor Coplanar Microstrip Lines Containing a Multilayered Magnetodielectric Medium

18600181a Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 1, Jan 89 pp 5-13

[Article by S. V. Mushenko]

[Abstract] This study applies previous results obtained for multiconductor screened microstrip lines with multilayered magnetodielectric media to the case of similarly screened slotted and multiconductor coplanar microstrip lines. The study focuses on a screened single-conductor coplanar line where the strip conductors on

the magnetodielectric substrate are in a "rectangular" screen configuration. The study derives integral equations for the surface magnetic charge densities and the longitudinal magnetic current for such a structure. This is used as the basis for developing a circuit model of the transmission line. The technique developed in this study is useful for analyzing a circuit containing a substantial number of plane-parallel conductors in a coplanar line. The present study is based on Kirchoff's laws solely for the magnetic currents and voltages.

Engineering Technique for Calculating the Interaction Forces Between a Current Source and a Conducting Screen

18600181b Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 1, Jan 89 pp 25-29

[Article by A. V. Bayko, Ye. F. Makarov]

[Abstract] This study demonstrates that an efficient method of calculating the pondermotive forces in an electrodynamic suspension system can employ an approximation of a weakly-expressed skin-effect. In this approach the dependence of the electrodynamic forces on the magnet velocity, the specific electrical conductivity of the material and its thickness is determined by a single joint parameter called the ultimate levitation quality. The weakly-expressed skin-effect approximation is used in the present study to obtain analytic formulae for calculating the levitation conditions for specific current source configurations. It is demonstrated that these formulae remain valid over a broad range of the ultimate levitation quality.

The Effect of a Linear Asynchronous Motor on the Electromagnetic Suspension System in an Integrated Propulsion-Levitation System

18600181c Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 1, Jan 89 pp 66-73

[Article by N. O. Sharendo]

[Abstract] This study develops a mathematical model of an asynchronous motor that makes it possible to account for the primary feature that differentiates the system used in a high-speed rail transport design from an ordinary asynchronous rotational motor: the substantial irregularity in the air gap. The study derives linear differential equations with constant coefficients for the phase voltages of such a motor thereby allowing their solution by analytic techniques. The equations are sloved by Laplace transforms. The system also develops a coefficient matrix to account for the interaction of the electromagnetic field and the asynchronous motor within a strictly-integrated system. The final relation determines the rigidity of the normal force component of the linear asynchronous motor averaged over the operating period; this value is dependent on the phase resistances of the stator and rotor windings, as well as the currents flowing through these windings and the steady-state gap and inductance values of the positive stator sequence. This motor can be used both for propulsion and levitation systems.

Scaling of Submicron GaAs Schottky gate FETs

18600182a MIKROELEKTRONIKA in Russian Vol 18 No 2, Mar- Apr 89 pp 99-105

[Article by K. A. Valiyev, V. I. Ryzhiy, G. Yu. Khrenov]

[Abstract] This study employs numerical modeling to investigate the scaling laws of submicron GaAs Schottky gate FETs and the results of two models are subsequently compared to determine their degree of reliability. A kinetic model underlies the numerical modeling process; this model is based on a joint solution of kinetic equations for the one-electron distribution functions and the Poisson equation for the potential of the self-consistent electrical field. The derived equations were solved by the direct macroparticle method with the macroparticle number of the order of 12,000 on rectangular, spatially uniform 33 by 106 and 17 by 22 node grids. A model with fixed mobility and a model with fixed velocity were employed. As anticipated the model with fixed mobility yielded elevated dependences of the drain current and the transconductance on the FET gate length, while the fixed velocity model yielded diminished results. Numerical modeling of the transistor series revealed that neither of the proposed simple scaling models yields a proper qualitative and quantitative description of the dependences of the drain current and FET transconductance on the gate length. It is also demonstrated that there is a strong shift in the threshold voltage of the FET towards negative values and a substantial growth in channel conductivity with diminishing FET gate length.

Modeling of the Operation of a Field-Effect Semiconductor Emitter in High Density Current Flow Conditions

18600182b MIKROELEKTRONIKA in Russian Vol 18 No 2, Mar-Apr 89 pp 106-111

[Article by V. E. Germ, N. V. Mileshkina, Ye. A. Semykina]

[Abstract] This study carries out direct statistical modeling of the operation of a field-effect semiconductor emitter in high current density flow conditions by the direct macroparticle technique, thereby allowing a more comprehensive description of all complexities of electron scattering by lattice and impurity vibrations. This study employs the method to obtain statistical and dynamic operational characteristics of the modeled emitter. The calculations were carried out for an *n*-type gallium arsenide emitter. The analysis reveals that the zero current approximation used in stratton theory may

break down in the field electron emission phenomena. Calculation results suggest that electron gas heating occurs even with low emission fields sufficient for barrier penetration by the tunnel effect. The increasing transparency of the potential barrier causes a situation whereby electron drift from the surface region due to emission is no longer compensated by their influx from the semiconductor bulk. The study concludes by claiming that the kinetic approach developed for modeling semiconductor emitter operation shows a substantial influence of the emission field strength on the electron distribution function and emitter operation.

Modeling of Strongly-Nonequilibrium Electron Phenomena in Submicron Si-gate MOSFETs

18600182c MIKROELEKTRONIKA in Russian Vol 18 No 2, Mar-Apr 89 pp 112-125

[Article by N. A. Banov, O. I. Kazmin]

[Abstract] This study derives a set of programs for modeling the electron processes in submicron Si-gate *n*-channel MOSFETs based on the kinetic model of electron plasma. The calculations run with this set are used to investigate the potential distribution in submicron MOSFETs. The derived data suggest that if effects associated with the irregular valley population, conductivity anisotropy of Si and other similar effects are ignored, the quasihydrodynamic model will prove adequate for modeling *n*- channel MOSFETs with a gate length of .1-.4 mcm in the subbreakdown voltage range, thereby allowing description of the dynamic characteristics of the electron plasma. Since the electron distribution function in the transistor channel is non-Maxwellian (the characteristic electron distribution function is unimodal in the transistor channel with a half-width in the momentum space approximately twice the average momentum of the charge carriers) this study concludes that the quasihydrodynamic model cannot be used to properly calculate the impact ionization coefficient. A kinetic description must therefore be used to model submicron Si MOSFETs in breakdown conditions.

Investigation of a Microwave Submicron Gate GaAs Schottky FET Equivalent Circuit

18600182d MIKROELEKTRONIKA in Russian Vol 18 No 2, Mar-Apr 89 pp 141-146

[Article by G. Z. Garber]

[Abstract] This study employs the inertia diffusion-drift model which is a simplified variant of the quasihydrodynamic model or a simple generalization of the classical diffusion-drift Shockley model to the case of submicron devices to analyze a GaAs submicron Schottky gate microwave FET equivalent circuit. The test equivalent circuit describes the operation of the active region in conditions where at any time the gate is negatively biased, guaranteeing the lack of a nonstationary Gunn domain, yet insufficient to cause impact ionization in the gate-drain area. The analysis reveals a second charge exchange mechanism of the Gunn domain involving a redistribution of electrons between the negatively and positively charged domain regions. The induction current flows through the source and the drain in this case. A plot of the time dependence of the drain current reveals that the relation is close enough to the result from two- dimensional dynamic modeling to suggest that the second charge exchange mechanism of the Gunn domain is implemented.

Power Equipment for Electric Centralization Sites at Major Stations

18600142a AVTOMATIKA TELEMEKHANIKA I SVYAZ in Russian No 1, Feb 89 pp 17-22

[Article by D. A. Kogan, Z. A. Etkin]

[Abstract] This article consists of two parts, one of which is devoted to a discussion and analysis of the PVP-ETsK rectifier converter panel, while the second section analyzes the design and function of the UZAT-24-30 automatic three-phase charger. The PVP-ETsK rectifier-converter panel is used for charging and boost charging of storage batteries and for generating a.c. levels of up to 1 kW for back-up power to light signal lamps and other battery loads. The panel also provides d.c. power to other circuits and electrical pneumatic valves for railroad turnouts. The PVP-ETsK panel has the following specifications: nominal three-phase a.c. input voltages: 380-220 V, storage battery d.c. voltage: 24 V; maximum storage battery load current: 45 A; maximum battery charge current: 50 A; and relay supply voltage range for battery switching: 23-27 V. The second section analyzes the UZAT-24-30 automatic three-phase charger. This charger is designed for charging acid storage batteries with a nominal 24 V operating level. It can also provide battery-free power to the load from the 3- phase a.c. mains. The device is designed for two operating modes: constant booster charging and forced charging. An external RNP semiconductor voltage relay and an NMSh2-1440 electromagnetic relay are used to switch operating conditions. The automatic three-phase charger has the following specifications: three-phase power supply voltage: 380/220 V plus or minus 10 percent; maximum charge current: 30 A. The efficiency at a maximum charge current is better than .6, with current drawn from the power supply running to 3.8 A. The unit dimensions are 550 by 362 by 375 mm with a weight up to 60 kg.

Application of Computer Technology to Calculating the Frequency Spread in Radio Communications Regions

18600142b AVTOMATIKA TELEMEKHANIKA I SVYAZ in Russian No 1, Feb 89 pp 31-32

[Article by G. V. Gorelov]

[Abstract] This article proposes a computer program for accelerating the process of calculating the frequency spread in radio communications regions published previously by Yu. V. Vavanov entitled "Communications with Mobile Facilities in Railroad Transport." This program is designed for a B3-34 programmable microcalculator and its analogs. The program text and possible parameter values are provided.

Recommendations to Improve Reliability of the RN-12B Radio Sets in Radio Communications Regions

18600142c AVTOMATIKA TELEMEKHANIKA I SVYAZ in Russian No 1, Feb 89 pp 35-37

[Article by S. A. Mikhaylov, V. A. Vinokurov]

[Abstract] This article reports a number of recommendations for improving the reliability of the RN-12B radio sets based on long-term operational experience. The article reports that the quartz resonators no longer fail if they are installed on the shock-absorption supports as shown in the text. The article also recommends installing wiring for the transmitter exciters and the first receiver master oscillator between the IS304 and IS314 integrated circuits and the channel switch. These wires must have a minimum length and be fastened tightly to the printed circuit board. This makes it possible to minimize the frequency drift of the receiver and transmitter when installing the radio set in a housing. Such a frequency drift may exceed 1 kHz for unmodified radio sets. The article also reports that the housing was sealed on radio set models manufactured between 1983 and 1984 by installing rubber spacers with thin aluminum washers under the potentiometers and the channel switch.

Estimation of the Susceptibility Properties of One Class of Radio Systems Influenced by Extensive Pulse Interference

18600169a IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31 No 12, Dec 88 pp 3-7

[Article by V. Ya. Kontorovich]

[Abstract] This study carries out an analysis of the influence of industrial pulse interference on radio systems consisting of signal sensors, amplifiers, analog-to-digital converters and individual processors. The analysis employs a special technique to estimate the noise immunity of information processing systems against a background of industrial interference; this technique considers the interfering mechanism of the industrial interference as a mechanism of "multiple" pulse interference sources appearing at intermediate points within the system circuits, while the overall system performance is evaluated to account for the entire range of interference. Several assumptions are made in the analysis. It is assumed that all sensors and amplifiers are linear, and their resulting frequency response is determined by a linear four-port. The individual processor operation is modeled by a queueing system of the type GI/G/I whose input and processing rates are known. It is also assumed that the system consists of k individual processors with a central node described by the queueing system and that at any point the industrial interference is modeled by independent Poisson inputs from single heteropolar pulses or interference pulse bursts with known intensities. This technique is then employed to calculate the susceptibility factor of the radio system for a given number of interference events and interference parameters acting on the system or, given an ultimate factor, to develop the requirements for reducing the interference. The derived formulae also make it possible to obtain the majority of radio system parameters of practical interest: average delay, average queue wait period, etc. The average queue wait and susceptibility factors are calculated for the sample system.

Computer Memory-Saving Algorithm for Application to Wave Routing in Matrix LSICs

18600115f Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31 No 9, Sep 88 pp 64-66

[Article by G. P. Mozgovoy, V. I. Chuykov]

[Abstract] This article develops a memory-saving algorithm for computer-aided design of large-scale integrated circuits. The algorithm is based on a design whereby all vertical coordinates of the base cell pins are replaced by two samples (they are "compressed") and information on the actual locations of the base cell pins is conserved; this provides a one-to-one conversion of the actual coordinates of any point in the base cell to the coordinates of the compressed base cell and vice versa. Information relating to the separate sections of the routes within the base cells and overlapping sections is not lost, since there are no vertical sections and the horizontal sections are "compressed" and "distended" in a one-to-one relation. The method of compressing based cells was implemented in a routing program used in the POST bipolar matrix LSIC design and routing system. The required RAM memory was reduced by a factor of two to five depending on the chip.

Printed Circuit Board Wiring Algorithm for Additional Connections

18600115g Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 31 No 9, Sep 88 pp 77-79

[Article by V. P. Sigorskiy, B. N. Druzhinin]

[Abstract] This article proposes a printed circuit board wiring algorithm for additional connections based on a topologic model of the printed circuit board in the form of a graph that reflects the binary blocking relation between the pair connections of the contact pads. The solution to the routing problem is reduced to decomposing the set of such pairs into an ordered set of subsets, where each such subset interconnects pairs implemented in the next stage. The article considers two possible algorithms for solving this problem. These algorithms are used to formulate an effective routing algorithm for printed circuit boards with additional connections. A generalized block diagram of the algorithm is provided in the article. The additional contact pad search algorithm described in the article is used to modify the selected connection pairs, after which a modified topologic model of the printed circuit board with additional connections is formulated.

Digital Linear Frequency Modulated Pulse Generator

18600119d Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 88 pp 91-93

[Article by N. I. Borodin, I. P. Bukanov]

[Abstract] This article describes a digital pulse generator design employing a simple circuit design with extensive functional capabilities achieved by replacing calculation of the phase code in specific time intervals with calculation of the time intervals during which a single change in phase of the linear frequency-modulated pulse occurs. The ROM memory is limited solely by the number of binary codes used to approximate the harmonic signal $\sin x$ for $x = 0\text{-}90°$ and the ROM is accessed by a linearly increasing (diminishing) curve. Calculation of the time intervals during which an identical phase change occurs is equal to deriving an sequence of pulses with a linearly-growing pulse repetition rate. In this design the oscillator

speed is limited by the ROM speed (the 505RE3) as well as the DAC speed (K572PA1), and can generate linear frequency modulated pulses with a base of less than or equal to 30 and durations of greater than or equal 30 ms for B = 30. The maximum pulse frequency is less than or equal to 2.5 kHz.

Phase Difference Measurement Instrumentation for Signals with a Random Frequency Ratio

18600119e Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 88 pp 100-103

[Article by N. I. Borodin, I. P. Bukanov]

[Abstract] This article discusses the design of a device that makes possible unlimited expansion of the phase sampling range of signals with a random frequency ratio without loss of speed or accuracy. The instrument consists of pulse shapers, accumulator-adders, programmable switches, a clock pulse generator, a digital-to-analog converter, a lowpass filter, and a register. The device was used to measure the characteristics of a high-precision kinematic reduction gear with a gear ratio of $138^2/17^2$. Rotation angle encoders at the input and output of the reduction gear and producing 8196 pulses per shaft revolution were used to generate the input pulse sequences. Measurement resolution excluding the lowpass filter was less than or equal to two minutes. The measurements were carried out in the standard rotation range of 10 to 6000 rpm.

Broadband Variable 360° Phase Shifter

18600119f Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 88 pp 103-109

[Article by N. S. Molchanov, V. F. Otchalko, N. N. Shtarev]

[Abstract] This article describes a variable 360° phase shifter in which the input stage preamplifies and splits the input signal into two voltages of opposing phases. These voltages are then injected into a broadband phase splitter which produces four signals of equal amplitude and successively 90° out of phase. An AGC amplifier is connected to the output of the phase-generating capacitor in order to achieve the necessary output voltage level and to eliminate amplitude modulation. Amplitude modulation of the output signal with phase variation from 0 to 360° over the entire frequency range is therefore less than 0.5 percent. The phase setting accuracy in the instrument is determined both by the parameters of signal injected to the phase shifter capacitor and by the characteristics of the capacitor itself. The error levels of the capacitor itself are comparatively low and normally can be eliminated by calibration. Experimental analysis has indicated a phase shift set error of less than plus or minus 6° over 0-360° range between 10 and 100 MHz. The input voltage range is 40-320 mV with an output voltage variable over .58-.67 V into a 50 ohm load.

Altimeter Data Processing Results from the "Venera-15" and "Venera-16" Automated Interplanetary Spacecraft

18600164a IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 31 No 11, Nov 89 pp 1295-1300

[Article by A. V. Abramov, A. F. Bogomolov, A. V. Grechishchev, N. V. Zherikhin, I. A. Zheltikov, V. P. Zaytsev, G. M. Levchenko, A. A. Morozov]

[Abstract] This article Discusses the radio altimeter data processing algorithms used on board the "Venera-15" and "Venera-16" missions to Venus. The spacecraft contained two independent instrument sets employing a common antenna for transmission and reception. Each set radiated probe bursts with a period of 0.6 sec; bursts from different sets were separated by 0.3 sec. Minimum distance from the surface to the spacecraft was near 1000 km while maximum distance was approximately 67,000 km. The period of revolution of the spacecraft was 24 hours with an orbital inclination of 87 degrees. An area greater than 7500 km in distance was imaged in a single imaging session; this plot began at 70-80 degrees northern latitude, extended through the polar regions, and was completed at 20-30 degrees northern latitude. The processing algorithms referenced the altitude measurements to the satellite ground trace points during radiation of the probe signal by the first equipment set. A 21- frequency band 1.85 kHz wide was extracted from the received burst. The middle of the central band corresponded to the direction of the satellite ground trace point for each frame while the remaining images contained altitude information in the ten preceding and ten subsequent frames. The article provides surface altitude measurement results for the planet Venus from the "Venera-15" mission for the imaging session of July 2, 1984. Average resolution for the flight route was 10 km while the resulting RMS altitude measurement error was estimated from different readings from the two independent instrument sets and varied from 30 to 70 m for the different sessions.

The Influence of the Atmosphere and Surface Roughness on the Radiometric Properties of Natural Terrain

18600166c RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 33 No 12, Dec 88 pp 2544-2550

[Article by V. A. Golunov, A. Yu. Zrazhevskiy, A. G. Pavelyev]

[Abstract] This study describes a radiophysical model that accounts for the influence of reflected atmospheric radiation and the terrestrial surface roughness in a Kirchoff approximation on the thermal radio emission

properties of natural terrain. The functions and parameters identified here make it possible to obtain comprehensive information on the scattering and radiative properties of the surface terrain in Kirchoff and single-scattering approximations. The analysis suggests that the radiophysical model can be used to describe the relationship between the scattering and radiative properties of natural terrain. Three parameters are used for a Gaussian distribution of the tangent of the angles of inclination of surface roughness to describe scattering and emission characteristics: the angle of observation, the permittivity of the medium and the dispersion of the tangent of the slope of the random irregularities. The model is used to determine the dependence of the effective radiation temperature of the terrain on the type of radiation polarization and the angle of observation accounting for the atmospheric reflected radiation. It is demonstrated that the methodological error of the model depends on the relative role of multiple scattering effects.

Optimization of Phase Modulation Principle for Radar Signal with a High Pulse Repetition Rate

18600166d RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 33 No 12, Dec 88 pp 2551-2557

[Article by A. G. Ryndyk]

[Abstract] This study analyzes the problem of developing interperiod compensation systems for passive interference conditions taking into account phase modulation of the probe signal and demonstrates the possibility of optimizing the phase modulation principle to achieve minimum dispersion of the uncompensated passive interference at the output of a whitening filter. It is demonstrated that when passive interference received from different ranges and having noncoincident energy spectra is present, optimization of the phase modulation principle provides a substantial advantage in passive interference suppression compared to the case of an unmodulated signal. This is valid when the values of the average Doppler frequency shifts are different. Both optimality conditions and sample optimum phase modulation principles are provided.

Possibilities for Improving the Measurement Accuracy of an Atmospherically-Scattered Optical Signal

18600166e RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 33 No 12, Dec 88 pp 2599-2603

[Article by Yu. A. Polkanov]

[Abstract] This study carries out a comparative analysis of scattered signal measurement accuracy for the following two cases: the case of a fixed signal recording interval corresponding to the necessary spatial resolution along the probe route and the case of signal recording intervals that grow in time in specific increments and have a common initial boundary. Two systems were used in the comparison: a lidar system as base system 1 and a system with expanding recording intervals as system 2. The advantages of system 2 were clear from the analysis. System 2 could be used to carry out measurements with a high degree of accuracy (approximately 1-10 percent) in the single signal scattering range over a broad range of atmospheric conditions and source radiation power levels of less than 1 MW. The system also eliminated the difficulties of achieving linear operation of the photoelectron multiplier for recording the scattered signal. Measurements could also be conducted with the same level of accuracy in daytime conditions. The narrow range of signal measurement error makes possible a more accurate interpretation when recovering the optical properties of the medium based on signal measurements.

Determining the Parameters of Extended Traveling Objects

18600166f RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 33, No 12, Dec 88 pp 2603-2607

[Article by N. S. Stepanov, S. Ye. Finkelshteyn]

[Abstract] This study is devoted to an analysis of the "secondary" Doppler effect in order to determine the parameters of traveling (specifically, vibrating) plane reflectors, including reflector dimensions in short-range radar conditions. A theory is developed to analyze the secondary Doppler effect and model experiments are conducted to verify the principal concepts of the theory. Since the analysis focuses on the amplitude modulation effect, the measurement installation also employs a square-law detector to record amplitude modulation of the echo signal. Metallic plates were used as the reflectors and the support structures made it possible to induce both frontal and angular oscillations in them. The tests revealed that, consistent with the theoretical analysis, angular oscillations of the reflector have a significantly weaker influence on the phase of the echo signal than due frontal oscillations. Analogous results were obtained for various reflector dimensions. Overall a joint analysis of the amplitude and phase modulations of the signal made it possible not only to determine the parameters of the reflector (its dimensions as well as oscillation frequency and amplitude) but also to select frontal and angular oscillations.

Edge Effects in Conical Multielectrode Deflection Systems

18600166g RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 33, No 12, Dec 88 pp 2607-2613

[Article by L. A. Baranova, N. P. Zanadrovov, Yu. A. Flegontov, S. Ya. Yavor]

[Abstract] This study is devoted to a theoretical and experimental analysis of conical deflection systems accounting for edge fields. The effective length of the deflection system is calculated in the theoretical analysis based on the determined axial field distribution. The

calculations were carried out for a large number of deflection systems whose parameters varied over a broad range: the angle of flare of the cone varied from 5 to 45 degrees, while the ratio of system length to the average radius varied from 2.0 to 6.0. In addition to length calculations the derived formulae were used to carry out field calculations at distances of $3r_0$ and $3r_i$ from the corresponding edges of the deflection system. The calculated values varied by a few percent. The effective length of the test deflection system was also determined experimentally using an electron-optical test bed. A lens was installed between the electron gun and the test system to focus the electron beam onto a luminescent screen. The shift of the electron spot at the screen was measured as a function of the potential difference applied to the electrodes of the deflection element. The measurements were carried out for two designs of the conical deflection systems. The measured effective length values are accurately approximated by the theoretical formula for deflection angles below 10 degrees. The method developed here can also be generalized to calculating the upper order field derivatives along the axis and the corresponding aberrational properties of the system.

Radar Measurements of the Vertical Intensity Distribution of Small-Scale E-Layer Turbulence

18600180d IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 32, No 1, Jan 89 pp 116-117

[Article by S. V. Antipin, V. A. Shaftan]

[Abstract] This analysis employs a high-power radar station producing several directional patterns and capable of detecting the radio aurora across the entire intensity range to measure the altitude distribution of signal intensity. The geomagnetic perturbations during the measurement period ranged from 40 to 100 nano Teslas. The intensity relations were analyzed for a spatial scale near 1 m. The processing algorithm selected near-stationary radio aurora forms extending for hundreds of kilometers and lasting for tens of seconds. A review of material passing the selection criterion revealed that the range of radio aurora intensities entering into the processing analysis varied from the weakest signals and extended to within an order of magnitude of the most intense signals. The analysis revealed that E-layer irregularities of characteristic scale near 1 mm result primarily from Farley-Buneman instabilities rather than gradient-drift instabilities, although available data made an unambiguous determination impossible.

Generation of Electromagnetic Waves in an Earth-Ionosphere Waveguide by Low-Frequency Sources. The Electrical Dipole Case

18600180e IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 32, No 1, Jan 89 pp 117-119

[Article by A. Ye. Reznikov, A. I. Sukhorukov]

[Abstract] This report presents results from a solution to the problem of VLF electromagnetic wave generation in an earth-ionospheric waveguide by an electrical dipole located in an inhomogeneous anisotropic polar ionosphere at altitudes of the order of the F-layer maximum. The report provides field calculation results in the near and far fields with respect to the projection of the source onto the terrestrial plane. The analysis suggests that a horizontal orientation of the radiation source is significantly more efficient than a vertical orientation. It is, however, pointed out that the analysis is valid for the polar ionosphere only when the angle of deviation of the magnetic field from the vertical is small. Otherwise a vertical electrical dipole may be more efficient than a horizontal dipole.

Automatic Control System for the AMTs-077 Industrial Laser Trimming Sets

1860176a Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 12, Dec 88 pp 28-29

[Article by V. B. Gerasimenko, A. V. Ryabukhin, V. P. Lyskov]

[Abstract] This study reports development of an automatic control system for the AMTs-077 industrial laser trimming sets which are commonly used in the manufacture of electronic resistors. The automated control system is based on an SM-1 computer and three AMTs-077 industrial laser trimming sets. Such sets operate by local heating of the resistor film of the trimmed resistor by means of a focused laser beam, thereby increasing the resistor resistance. The automatic control system for the laser trimming sets performs the following functions: monitors the resistor preforms and the equipment condition; performs remote control functions on the equipment during resistor preform control and trimming; performs automatic and analytic analysis of the parameters of the trimming process; provides protection and blocking to equipment circuits, and indicates both operational failure and operating mode status. The software package for the automatic control system is contained in a single load module consisting of a standard program package and a set of special Fortran programs. ASPO is used as the standard software; this supports module loading and makes it possible to set up the hardware configuration for monitoring and laser trimming of the resistor preforms with the desired speed and accuracy.

Automated Test Instrumentation for Measuring Nonequilibrium Charge Carrier Lifetime in Silicon Preforms and Wafers

1860176b Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 12, Dec 88 pp 29-30

[Article by A. V. Zaytsev, G. I. Lobanov, V. P. Romanova, N. B. Andreyeva]

[Abstract] This article discusses the development and application of the AMTs-0767 automated test system for measuring the nonequilibrium charge carrier lifetime in silicon preforms and wafers. This system includes a nonequilibrium charge carrier lifetime measurement device which produces the injected and test current pulses, injects these pulses to the test specimen in a specific sequence and then derives and processes the subsequent measurement results. The system also includes a manipulator which is used to fit, orient, attach, and mount monocrystalline silicon preforms and wavers of various lengths and diameters. The systems specifications are as follows: nonequilibrium charge carrier lifetime measurement range, mks, 2-1000; relative measurement error, %, plus or minus 20; measurement range of injected and test current pulses, amps, .005-.05; silicon preform and wafer test speed, remote control mode, 48-2-443-83, units per hour, 60; power consumption, kV.A, less than 1; dimensions, mm, 1360 by 830 by 1420. This system has been used successfully to improve the characteristics of silicon wafers and preforms due primarily to its enhanced measurement properties. The system has also been used to improve labor productivity by virtue of automation of measurement processing results and digital generation of final measurement results. The system can be used to expand the nonequilibrium charge carrier lifetime measurement range and to test preforms and wafers of a larger size.

Automated System for Local Microwave Measurement of Electrical Resistivity

1860176c Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 12, Dec 88 pp 31

[Article by N. I. Davydov, G. I. Tyulkov, A. G. Levashkin, A. V. Kuznetsov]

[Abstract] This study describes the development of the AMTs0766 automated system for local microwave resistivity measurements for application to semiconductor materials. The system operates in the following manner. The material specimen is mounted in a holder and is then clamped. A transducer fed from a microwave oscillator is installed in a vertical displacement manipulator. During operation the transducer drops down to the specimen and after recovering information stands the specimen in a single step. A step-driven X-Y control mechanism is used to move the transducer across the specimen. The coaxial transducer detects microwave power losses caused by the semiconductor specimen. The vertical displacement mechanism allows continuous "nonshock" advancement of the transducer to the specimen. This system has proven useful in generating high-quality electrical resistivity measurements in semiconductor materials.

The UAKM-4 Automatic Magnet Tester

1860176d Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 12, Dec 88 pp 32

[Article by V. I. Puchnin]

[Abstract] This study discusses the design and operating principle of the UAKM-4 automatic magnet tester for application to automated industrial sorting and rejection of permanent magnets used in measurement instruments. The tester consists of an injection and synchronization unit, a magnetization unit, a test and distribution unit, and a demagnetization unit. The tester employs a pulsed capacitor-type magnetization unit to generate the necessary magnetic field intensity for automatic magnetization; this is a more cost- effective method of producing a powerful magnetic field. Tester specifications are as follows: degree of magnetization: to saturation; number of magnet sorting groups: 3; magnetic induction, milliteslas, as basis of magnet sorting: first group: less than 174; second group: 174-190; third group: greater than 190; sorting accuracy, percent: 2.5; speed, units per hour: 1000; supply voltage, volts: 220 (50 plus or minus 1 Hz); dimensions, mm: 1620 by 550 by 1100; weight, kg: 120.

Radio Occultation of the Earth's Atmosphere by EHF Waves

18600180a IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 32, No 1, Jan 89 pp 3-10

[Article by S. D. Eliseev, O. I. Yakovlev]

[Abstract] This study analyzes the capabilities of radio occultation of the terrestrial atmosphere in the EHF band using two spacecraft. The anticipated absorption levels near the water vapor lines (13.5 mm and 1.63 mm) and the molecular oxygen lines (2.5 mm and 4.93 mm) were determined as a function of season. It is demonstrated that radio wave attenuation measurements in these ranges can be used to investigate the humidity and air density profiles to altitudes of 30-40 km. Radio wave absorption in the transmission windows of the EHF band is analyzed for 8.6 and 3.3 mm. The analysis shows that absorption can be ignored for a cloudless atmosphere when minimum ray altitude exceeds 15 km. In the lower atmospheric layers absorption becomes significant and variations in absorption are caused principally by humidity variations.

Calculation of the Tolerable Parameter Range of the Data Medium in an Optical Memory with Bit Data Representation

18600111b Novosibirsk AVTOMETRIYA in Russian
No 5, Sep-Oct 89 pp 55-60

[Article by O. M. Motruk]

[Abstract] This article carries out a calculation of the tolerances on such parameters as inclination and tapering of the data media, planarity, bifringence, and the dimensions of nontransparent inclusions for monochromatic radiation in the data medium of an optical memory with bit data representation for the case where the residual aberration of the focusing objective at the axial point is equal to zero and its incoupling pupil is filled with a Gaussian beam. This article considers two phenomena to have a negative influence on the operation of the memory: degradation of laser radiation focusing due to coma aberrations and an axial shift of the reflected beam which may produce a false match signal in certain focusing and tracking systems. The relations derived in the study to calculate the various tolerances make it possible to obtain information on the tolerances for the data medium in an optical memory which is necessary for designing optical memories with bit data representation.

A Modification of the Resonator Technique for Measuring the Voltage Standing Wave Ratio

18600170c Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 1, Jan 89 pp 57-59

[Article by V. P. Turyanskiy]

[Abstract] This article employs a matrix representation of a resonator to derive a strict formula and to propose more effective variants for measuring the voltage standing wave ratio; the measurement error of such techniques is also estimated. The proposed variants of the measurement technique are implemented on an assembly consisting of a microwave oscillator, ferrite isolators, isolation attenuators, a polarization attenuator, and a resonator. The resonator is formed in a standard 23 by 10 rectangular waveguide using two diaphragms. One diaphragm is adjustable, while the other is a flat metallic screen containing a hole at the center of the rectangular waveguide cross- section. A set of four plane-diaphragms with different hole diameters and, consequently, different gains, are used in the measurements. The successive use of such diaphragms made it possible to alter the coupling factor over a rather broad range during the experiments. The experimental results indicate that the voltage standing wave ratios of identical standards are quite varied for different resonator-test load coupling factors. At the same time the voltage standing wave ratios measured in accordance with the proposed resonator techniques discussed here were virtually independent of the degree of coupling and their differential from the voltage standing wave ratios of the standards did not exceed 0.7 and 0.5 percent respectively for design variants I and II. On the one hand these results suggest that certain previous formulae are incorrect and, on the other, confirm the validity of the formulae derived in the present study and indicate that the error levels of the resonator technique are comparable to the error levels of voltage standing wave ratio measurements carried out by means of a tunable reflectometer.

Comparison of Theoretical and Experimental Dependences of Field Strength on Range for a Hiroiso (Japan)-to-Ship (Antarctica) Route

18600180b IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 32, No 1, Jan 89 pp 11-16

[Article by I. A. Tushentsova, Ye. Ye. Tsedilina]

[Abstract] This study carries out a comparison of the theoretical and experimental dependences of the field strength of shortwave signals on range for a Hiroiso (Japan)-to-ship (Antarctica) route. The analysis focuses on such elements as the change in electrical field amplitude with range (measured in decibels) and the change in the relative electrical field amplitudes with range. Plots of the variations in the calculated field strengths of modes of maximum amplitude as a function of range are provided for frequencies ranging from 10 through 30 MHz. The figures indicate that in many cases an acceptable agreement is achieved between calculated and experimental data. In order to determine the nature of variation in the field amplitude along the route curves reflecting the change in field strength in relative units are provided. These curves eliminate the influence of the radiation power level on signal amplitude. The results of these analyses indicate that in spite of some necessary analysis data and the use of the RMI-81 ionospheric model to calculate signal parameters a satisfactory agreement is achieved between the calculated and experimental dependences of field strength on range for many frequencies and times.

Analysis of Shield Currents in Plastic-Insulated High-Voltage Cables

18600123c Moscow ELEKTROTEKHNIKA in Russian No 5, Jan 89 pp 19-23

[Article by K. P. Kadomskaya, Yu. A. Lavrov, O. M. Khorosheva]

[Abstract] This article proposes a technique for determining the currents flowing through shields in normal and emergency conditions for any cable phasing method and also estimates the effectiveness of several measures to reduce the currents in AP_BP 110 kV cable screens for cable cross- sections of 350 and 625 mm^2 in short-circuit conditions. The analysis reveals that from the viewpoint of current levels flowing through the screens in both normal operation and in short circuit conditions it is most advisable to phase the cable lines at the apexes of a single proper triangle. The currents flowing through screens in both normal operations and in a three-phase short circuit to ground with such phasing does not exceed .12 I_c. It is also possible to reduce the ratio of the screen current to the conductor current for the case of a short circuit in a network containing cable lines 625 mm^2 in cross-section by installing an additional grounded wire in the center of the phase triangle.

The Reception Noise Immunity of a Bipulse Signal in Spectral-Division Multiplexing of Digital Optical Signals

18600126c ELEKTROSVYAZ in Russian No 1, Jan 89 pp 23-24

[Article by R. M. Sharafutdinov]

[Abstract] This study analyzes the reception noise immunity of a bipulse signal for the case of spectral-division multiplexing of digital optical signals to account for the influence of transient noise assuming that mutual influence between the optical channels is identical and is determined solely by the two neighboring channels in the spectrum. The analysis focuses on an absolutely bipulse signal where the binary character one is transmitted by the combination 10 while the character zero is transmitted by the combination 01. The study calculates the difference voltages at the input of the receiver decision device for the case where a 111 combination and a 000 combination are transmitted. This is to demonstrate that the conditional error probabilities in both cases are equal. The study also calculates the dependences of the average error probability on the signal-to-noise ratio for these signals. A comparison of the noise immunities of bipulse signal reception and reception of a passive pause signal employing strobing suggest that it is possible to reduce the crosstalk attenuation between the optical channels by 2-3 dB by employing a bipulse signal in a spectral division multiplexing system and, consequently, to improve the engineering and cost efficiency of the spectral-division multiplexing fiber-optic communications link.

Estimate of Duration Distortions to Discrete Signal Elements from Transmission by Asynchronous Methods

18600126d ELEKTROSVYAZ in Russian No 1, Jan 89 pp 30-32

[Article by A. S. Adzhemov, R. A. Khalidov]

[Abstract] This study estimates the duration distortions of discrete signal elements already containing distortion with a given probability function for the case of transmission by asynchronous techniques. The proposed method of calculating the probability density function of duration distortions in discrete signal elements is applied to a random number of asynchronous transmission cycles. The routine developed in this study can be used to calculate the probability density function of duration distortions to discrete signal elements with a random number of asynchronous resenders. The analysis suggests that in asynchronous operation an element of duration T can be either lengthened to $T_y = (s_x+1)\tau$ or shortened to $T_y = s_x\tau$ with the lengthening probability $p_\alpha = \gamma_x - s_x$ while the shortening probability is $p_\beta = X_x + 1 - \gamma_\alpha$. The probability density function of the output distortions is therefore discrete while the probability of distortions appearing will depend on the probability of an element of duration t appearing. These results can be used to calculate the performance characteristics of time-division multiplexing equipment.

Municipal Telephone Network Line Signaling System: Transmission Code for Line Signals on Two Dedicated Signal Channels

18600126e ELEKTROSVYAZ in Russian No 1, Jan 89 pp 32- 36

[Article by V. I. Kolbasova, E. A. Melamud]

[Abstract] This article is one of a series intended to give survey coverage to long-term research on individual circuit signaling and also contains recommendations on improving existing interexchange communications equipment and on developing new such equipment. The study carries out a detailed analysis of the types of signals transmitted on the line signaling system in municipal telephone networks. The various functions performed by such signals and the changing conditions in both sending and receiving equipment are discussed. Such signals as "busy", "release calling subscriber", "disconnect", "check incomming status", "blocking", "response of called subscriber", "drop request", "release called subscriber", "call sending", "subscriber available", "response of called subscriber", etc. are analyzed together with the various techniques and transmission codes for sending line signals. The study also carries out a detailed analysis of the line signal transmission code used on municipal telephone networks for transmission line signals on the IKM-30 equipment.

The Search for New Communications Systems for Interplanetary Travel

18600126f ELEKTROSVYAZ in Russian No 1, Jan 89 pp 57-58

[Article by S. V. Novakovskiy]

[Abstract] This article discusses the importance of developing new communications equipment and techniques for interplanetary and interstellar travel. Based on a review of current communications methods and the likely requirements for long-range interplanetary space travel this article concludes that it is necessary to develop information transmission techniques in which the messages transmitted travel at speeds far exceeding the speed of light. This study recognizes that although new forms of superrelativistic communications are required, no such systems have been demonstrated nor identified to date. However, the article briefly discusses the hypothetical particles called tachions that are purported to travel at superrelativistic velocities. Additionally the article cites recent quazar studies that suggest that quazars are produced by particles traveling at velocities ten times greater than the speed of light. Tachions are identified as one possible promising medium for future messages at speeds far exceeding the speed of light.

From the Communications Specialists of the Nation to the Armenian Earthquake Survivors

18600126g ELEKTROSVYAZ in Russian No 1, Jan 89 pp 4, 64

[Article by G. G. Kudryavtsev]

[Abstract] This article discusses the initial efforts to establish communications in Armenia following the recent earthquake together with remaining problems existing in the area resulting from earthquake damage. The article reports that in the initial hours following the disaster Armenian communications specialists as well as staff from the TPO-24 communications enterprise initiated attempts to restore communications. They were subsequently joined from workers from the various union republics and military communications specialists. Two days after the earthquake long-distance communications to Moscow and other cities around the country along with 50 telephone channels and communications links between Yerevan and all regional centers. By December 17 communications had been restored on the republic cable and radio relay links and to the television center in Spitak, which made it possible to provide television broadcasting to the entire earthquake area. By December 19 180 additional channels were put into service connecting the area to Moscow as well as the capitals of the union republics and the regional centers of the country. It was, however, later recognized that the communications specialists were not prepared to handle the problem of restoring communications in emergency earthquake conditions nor were they schooled in the use of mobile communications, radio, or radio relay link operation. The article also discusses several subsequent measures taken by local regional authorities to assure housing and support for communications workers as they attempted to restore radio and telephone communications, television broadcasting, mail, and wire service to the stricken regions.

New Developments in Cable Installation Technology

18600102a AVTOMATIKA TELEMEKHANIKA I SVYAZ in Russian No 11, Nov 88 pp 10-12

[Article by D. A. Popov]

[Abstract] This study analyzes existing techniques and standards on cable installation for automation and communications applications. The analysis focuses on TU16.505.118-75 and TU16.505.189-76 cables employed in long- range railroad communications. The analysis indicates that automation and communications cables employing polyethylene protective jacketings and installed at distances of 10 to 50 m from the raliroad beds in sections employing independent traction and d.c. electric traction should be installed with electrical-insulating, gas-impermeable couplings at the junctions. The long- distance cables are also protected from extraneous electromagnetic interference by grounding their sheathing at 3 points. This cable installation technology makes it possible to monitor the integrity of the polyethylene protective sheathing and also eliminates sheathing faults while making it possible to measure the cable sheathing potentials and improve their service life.

The Reliability of Railroad Radio Communications

18600102b AVTOMATIKA TELEMEKHANIKA I SVYAZ in Russian No 11, Nov 88 pp 14-17

[Article by Yu. V. Vavanov, A. I. Yashin]

[Abstract] This article is devoted to an analysis of redundancy as a method of assuring radio communications reliability in railroad transport. Redundancy is identified as the only means of improving reliability in railroad radio transportation since such reliability is dependent on many uncontrollable factors such as the electromagnetic field strength of the legitimate signal, the radio noise and signal levels from interfering stations and atmospheric interference. The study proposes adding back-up channels on the assistant station master-locomotive engineer or the dispatcher-locomotive engineer routes as a means of improving radio communications reliability. The study concludes that installing a back-up capability and logging all transmissions will help to create the groundwork for transforming railroad radio communications into a primary means of railroad traffic control.

Multiplex and Selector Channel Switchers for the YeS Computer

18600142d AVTOMATIKA TELEMEKHANIKA I SVYAZ in Russian No 1, Feb 89 pp 38-41

[Article by B. S. Braylyan, A. B. Yavorskiy]

[Abstract] This article reports the development of a family of switchers for use in the YeS computer series: a multiplex channel switcher, a selector channel switcher and a display channel switcher; these devices make it possible to switch from an automated real-time transport control system or a DISCOR system to any of four YeS1035 computer systems without loss of information. The multiplex channel switcher is designed for modifying the configuration of a computer complex consisting of four YeS computers on a multiplexed channel. The switcher can implement rapid switching of any group of peripherals to the multiplexed channel of any of the four central processor computers. The selector channel switcher is designed to connect each YeS2435 processor to three of the six YeS5568 controllers (or their analogs) in the computer room with its own group of YeS5061 devices. The display complex switcher is a switching panel containing the necessary number of SR75-66FB connectors that are hard- wired to all four YeS7922-01 devices. Cables are connected to the other end of the switching bay and these cables run through type SR75-54PV connectors to the YeS7927-01 devices. These switchers are used to implement a flexible hardware switching system that provides 100 percent hardware backup and improves the functional reliability of the joint automated real-time transport control system/ DISCOR system.

Certain Issues in the Measurement Accuracy of Ionizing Radiation Measurements

18600165e Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian
No 1, Jan 89 pp 69-74

[Article by F. B. Grinovich, A. S. Protsenko]

[Abstract] In this article the authors have attempted to generalize existing experience and theoretical results from a variety of reports of radioactive radiation measurements. Primary attention has been devoted to determining the accuracy in radioactivity measurements of various substances. The primary issues identified as problem areas in radiation measurements include: 1) not all particles or gamma quanta will impact the detector element. This refers to the 2π-detector geometry if all particles and gamma quanta in one hemisphere strike the detector element or the 4π geometry if the radioactive substance is surrounded by the detector element. 2) All particles and gamma quanta striking the detector element and producing ionization will not be recorded by the detector nor counted by the counter, since they have a finite speed. If the instrument employs a Geiger-Muller detector the resolution of the device will largely be determined by the detector itself as the instrument with the greatest lag. 3) Backscattering may significantly elevate measurement results. 4) Significant errors may also arise from absorption in the radiation source. 5) The counter window may also significantly attenuate radiation levels. Finally, atomic decay is a random process which obeys a Poisson distribution. These facts all impose certain constraints on radioactivity measurement accuracy and must be taken into account in conducting experiments.

Circuit Engineering and Design Techniques for Achieving Electromagnetic Compatibility in Transistor Fixed-Voltage Converters

18600168a ELEKTRICHESTVO in Russian
No 2, Feb 89 pp 37-43

[Article by T. A. Glazenko, V. I. Senkov]

[Abstract] This article recommends a specific sequence of design and development steps coupled with electromagnetic compatibility measures for 100 W or higher fixed voltage converters based on design experience and an analysis of the literature sources. The steps include the following: 1) analysis of the technical design to account for electromagnetic compatibility requirements, selection of the design of the power section of the fixed voltage converters and its component base; 2) determination and evaluation of possible sources and receivers of RF electromagnetic interference in the fixed voltage converters and a prediction of the RF electromagnetic interference levels; 3) selection of optimum operating conditions of switching elements in fixed voltage converters; 4) filtering and suppression of interference voltages in fixed voltage converters; 5) design of fixed voltage transistor converters accounting for electromagnetic compatibility requirements. The study claims that this set of circuit engineering and design techniques to provide electromagnetic compatibility of fixed voltage transistor converters makes it possible to reduce the level of RF electromagnetic interference at the input and output by 60 to 30 dB for symmetric interference and 45 to 20 dB for asymmetric interference over a normalized frequency band. It is also pointed out that the proposed sequence of design stages accounting for electromagnetic compatibility requirements will reduce the number, weight, and size of the RF filtering components and noise suppression filters and will also reduce the cost, design and development and construction time of devices employing transistor fixed voltage converters.

Calculation System for Real Time Analysis of Algorithms for Digital Relay Protection Devices

18600104a Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian
No 10, Oct 88 pp 26-33

[Article by A. N. Birg, B. S. Zaytsev, E. M. Shneverson]

[Abstract] This article discusses the primary aspects of designing a program model for investigating algorithms for real time digital relay protection devices and provides specific results for digital remote protection of power transmission lines. The study develops a calculation system for analyzing the properties of a remote digital measurement device; this system models in real time the calculation processes, the intercomputer swapping cycles, and the interaction operations with peripherals. The design, component parts, and performance of this system are discussed. This calculation system is an effective tool for analyzing processing the necessary dynamic properties of digital relay protection devices. It can be used to investigate the properties of protection systems in conditions of both irregular changes in sinusoidal signals and to account for the components of transient processes that occur during short circuits. This process is determined by the solved equations of the model and is independent of any structural changes in the calculation system.

Rectifier Expulsion Fuse

18600104b Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian
No 10, Oct 88 pp 85-89

[Article by A. A. Sivkov, V. L. Korolkov, I. N. Astshkin, A. G. Chervyakov]

[Abstract] This article reports the development of a high-speed 1000 A, 1500 V rectifier expulsion fuse. Long-term fuse tests at a current of 1000 A demonstrated that in a +20°C environment a fixed high temperature range is established after 2 hours. Such a peak temperature level allows reliable operation of the fuses at environmental temperatures of +40°C accounting for the +70°C operational temperature limit on the electrical fuse firing element. Switching tests of the expulsion fuses on a laboratory test stand confirmed that the fuses reliably fire at short circuit current pulse rise rates of 10^{-2} to 10^{-1} A per mcs. The delay relative to the reverse current flow varies from 4.5 ms to 1000 mcs. This rectifier expulsion fuse can be used to protect semiconductor power converters from external fault events. The nominal current and voltage performance parameters of the fuses can be improved by a factor of several times with only minor changes in size and weight.

Magnetodielectrics in Power Protection and Control Devices

18600104c Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian
No 10, Oct 88 pp 90-95

[Article by V. V. Mikhaylov (deceased), I. I. Kalinin, V. V. Mikhaylov]

[Abstract] This study analyzes the advantages of magnetodielectric components, specifically magnetodielectric current transformers, for application in current-limiting, current-measuring, and magnetic-screening protection and control devices. Prototype single-turn magnetodielectric current transformers were designed and fabricated; these devices had the following parameters: nominal current (1): 800 A; nominal current (2): 1 A; relative maximum magnetic susceptibility of magnetodielectric material: 130; length of average magnetic field line: .36 m; magnetic conductor cross-section: 4 cm^2; total resistance of secondary winding and load: 2 ohms. Analysis of the coil shapes revealed that from the viewpoint of inductance and coil weight the most optimum coil cross-sections is a near-square cross-section design. The study also analyzes the use of magnetodielectrics in screening devices and calculates the screening coefficients of each such layer as well as the total screening coefficient for screens fabricated from 3413 steel and a magnetodielectric based on PZh ferrous powder. It is determined that it is advisable to use magnetodielectric conductors based on PZh ferrous powder for protection and control instruments employed in power engineering; such materials will provide the necessary range of magnetic properties. The study also claims that hysteresis losses in magnetodielectric conductors in electrical power equipment are comparable to those in commercial electrical steel conductors operating in analogous conditions.

How Loaded Lines Influence Cable Fault Detection by the Induction Technique

18600168b ELEKTRICHESTVO in Russian
No 2, Feb 89 pp 56-59

[Article by V. V. Platonov, S. N. Dyachkov]

[Abstract] This article develops a technique and analytic expressions for calculating the magnetic field strengths produced by a loaded cable line or a group of such lines together with an analytic expression for evaluating the degree to which loaded cable lines influence fault detection by the induction technique. It is demonstrated that in the most unfavorable conditions the noise factor is as high as 58 dB for two cables in the duct and 65 dB for six cables in the duct. A calculation method is developed and quantitative estimates of the magnetic field strength produced by a loaded overhead line are provided. It is demonstrated that a line with horizontal wiring generates the greatest vertical magnetic field component. This study also derives an analytic expression for estimating the interference of loaded overhead power lines on cable

troubleshooting by the induction technique. It is demonstrated that the noise factor is 60-65 dB with actual cable line characteristics and can rise to 80 dB in the case of the most unfavorable combination of factors.

Integration of a Synchronous Generator and a Thyristor Frequency Converter: A New Class of Synchronous Generators

18600167a ELEKTROTEKHNIKA in Russian
No 2, Feb 89 pp 6-8

[Article by Ya. B. Danilevich, Ye. G. Plakhtyna]

[Abstract] This article focuses on designs and operating characteristics of a new class of synchronous generators representing an integration of synchronous machines and thyristor frequency converters. The analysis focuses on such an integrated synchronous generator: the 500 kW generator developed at the All- Union Scientific Research Institute of Electric Machinery and Equipment Engineering Technology designed for operation in a wind-driven power plant consisting of a wind-driven motor, the generator, a thyristor power converter with a d.c. circuit, a transformer, and an automatic control system. Equations are given to characterize the electromechanical processes occurring in such a system. Special attention is devoted to the operating features of a wind-driven power plant. This is a unique power plant as initially it operates as a motor and then converts to generator operating conditions.

Design Tools for Simulation of Electric Drive Microprocessor Control Systems

18600167b ELEKTROTEKHNIKA in Russian
No 2, Feb 89 pp 73-76

[Article by A. V. Baluev, V. N. Nuzhdin, A. B. Shubin]

[Abstract] This article focuses on the development of a program design set of tools for simulating electric drive microprocessor control systems with the following capabilities: the capability to simulate microprocessor system operation on two levels: the control algorithm level and the machine control program level with proper reproduction of the interaction of parallel processes in the microprocessor set and the control object; the capability to simulate the control object with adequate reflection of the discrete and stochastic functional factors; and the capability to support an interactive analysis and design routine combined with convenient means of display and representation of simulation results. The operation of the system is based on a specially-developed mathematical model of the system as two interacting piecewise-linear sets, one of which is the microprocessor unit consisting of models of the central processor, the RAM, and the input-output interface while the second set is the control object containing the model of the electromechanical system and its interface with the microprocessor. The simulation system at present has the following capabilities: can simulate objects to the hundredth order of an equivalent system of differential equations, has a broad component base for formulating models, can automatically calculate the necessary parameters of the model based on a Fortran program prior to a calculation experiment, i.e., in calculating the parameters of a digital regulator in an automatic control system; has syntactic, semantic, and structural check capacity over model function, outputs simulation results in both tabular and graph form for transient processes, and also provides tables of the performance characteristics of the control system and the primary specifications from statistical processing. The system also has the capacity to debug control programs written for the K589 and K1819 series microprocessor sets.

Laminated Plastics for Electrical Engineering Applications Based on Modified Phenol-Formaldehyde Resins

18600167c ELEKTROTEKHNIKA in Russian
No 2, Feb 89 pp 76-77

[Article by G. M. Dulitskaya, E. F. Zenin, M. I. Doronina, K. S. Sidroenko, A. L. Panin, M. N. Muzafarova]

[Abstract] This study presents a modification of the resol-type phenol- formaldehyde resin that incorporates caprolactan in the binder. Caprolactan combines well with the phenol resins in any component ratios. Such composite materials are stable, have long storage lives, and are easy to manufacture. The article presents the primary performance characteristics such as failure stress and electrical strength as well as proper component ratios for these compounds. Stratified plastics based on the modified phenol-formaldehyde resins are currently manufactured by the facilities of the Soviet Ministry of the Power Engineering Industry and Power Machinery Manufacture. The article states that these products are comparable to the best foreign products in terms of performance.

Improvements in the Manufacturing of Oil-Filled Cable

18600174a ELEKTROTEKHNIKA in Russian
No 12, Dec 88 pp 7-10

[Article by S. Ye. Gleyzer, Yu. V. Obraztrsov, M. Yu. Shuvalov, G. I. Peshkova]

[Abstract] This study optimizes oil filled cable designs based on insulation thickness. The study focuses on a determination of the dielectric characteristics of the insulation paper used in such cables in order to substantiate the calculation of minimum insulation thickness. It is determined that the minimum necessary insulation thickness is achieved using electrical insulation materials manufactured in the Soviet Union. Tests on low-pressure oil-filled cables also revealed that for electrical field intensities and temperatures ranging up to 30 MW per meter and 125 degrees C, respectively, insulation aging is not due to partial discharges but rather to thermal breakdown of the insulation components and is accompanied by an increase in the tangent of the dielectric losses in time. Finally, the study develops a high-pressure oil-filled cable design operating at 220 kV with an improved insulation structure 15 mm thick based on the research results.

Investigation of the Electrical Strength of 110 kV Plastic-Insulated Cable End Couplings

18600174b ELEKTROTEKHNIKA in Russian
No 12, Dec 88 pp 10-13

[Article by L. Ye. Makarov, Yu. F. Telezhnikov, L. G. Shvartsman]

[Abstract] This study provides results from a experimental and analytic investigations intended to improve the electrical strength and modernize end coupling designs. The tests were performed on cable end couplings of 350 mm^2 in cross-section employing pressurized reinforcement insulation in the cable compartment with a cylindrical diameter of 150 and 115 mm and porcelain insulators with internal diameters of 160 and 120 mm. The experimental tests revealed that in calculating insulation for end couplings it is necessary to account for the tolerable electrical field strength levels both at commercial voltage levels and for pulsed voltages accounting for the insulation materials used in the coupling and their operating conditions in electrical fields. Several coupling designs are provided as well as appropriate ranges of operating parameters in pulsed and commercial power applications.

Evaluation of the Fire Resistance of Electrical Cables

18600174c ELEKTROTEKHNIKA in Russian
No 12, Dec 88 pp 22-25

[Article by E. T. Larina, O. V. Krekhova, M. K. Kamenskiy]

[Abstract] This study carries out tests on a number of domestic Soviet brands of power cable to establish safe operating ranges with respect to fire retardant and fire resistance capabilities. Initial tests were performed on I-40- 13 and I-40-14 cables employing polyvinylchloride insulation. The test results indicate that in order to satisfy modern fire resistance requirements it is necessary for the equivalent oxygen index of cable designs employing polyvinylchloride insulation to remain below 29. It is also established that in order to assure that the cable testing method most closely approximates actual operating conditions it is important to minimize the dimensions of the cable section outside the gas flame region.

Experimental Investigations of the Attenuation Coefficient of Heat- Resistant Cordyl-Insulated Cables

18600174d ELEKTROTEKHNIKA in Russian
No 12, Dec 88 pp 32-35

[Article by O. M. Kovaleva, B. V. Malkov, A. A. Pavlov, Ye. I. Prislonov]

[Abstract] This study reports results from experimental investigations of the attenuation coefficient of cables under the joint influence of temperature, elevated pressure, and bending. The tests were performed on semirigid and highly-flexible RF cables insulated by spiral cordyl fabricated from fluoroplast-4 D. The semirigid cables had insulation diameters of 3.7 mm and 7.25 mm, and copper, silver plated one-wire inner conductors and corrugated copper outer conductors. The tests determined that the RF cables with these insulation properties operate efficiently over a broad range of frequencies, vacuum temperatures, and mechanical stresses. At normal pressure the cable attenuation grows by 30-40 percent when the temperature rises from minus 80 degrees C at frequencies above 1 GHz and 10 to 20 percent when the temperature drops to minus 200 degrees C. It is also determined that the attenuation coefficient in vacuum conditions is lower across the entire frequency and temperature range than at normal atmospheric pressure: the effect of rising attenuation with diminishing temperature is not in evidence.

Design Optimization of Water-Resistant Magnet Wire

18600174e ELEKTROTEKHNIKA in Russian
No 12, Dec 88 pp 35-40

[Article by V. Yu. Kuzenev, Z. N. Koltsova, A. A. Gnedin, G. I. Meshchanov]

[Abstract] This article carries out tests on a variety of water-resistant magnet wire brands currently used in the Soviet Union. The tested brands include the PEVVP, PVDP-1, PVDP-2 ppVP, and PPVM water-resistant magnet wire designs. Such performance characteristics as operating voltage, working temperature, insulation

material, conductor size, insulation thickness, etc. are reported together with the fundamental properties of polymer materials used in these designs. The study also analyzes the electrical field strength distributions in wire insulation, the time-to-failure as a function of applied voltage and the performance properties of the wires as a function of temperature. These tests show that existing polyvinylchloride insulation cannot be used to achieve high performance of these wire brands. The study also identifies promising insulation materials including brand 271 high-density polyethylene insulation and brand 22015 propylene-ethylene copolymer insulation.

Superconducting Circulating 2.8 Tesla Solenoid

18600119g Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian
No 5, Sep-Oct 88 pp 158-164

[Article by L. B. Luganskiy, I. B. Danilov, A. V. Dubrovin, V. I. Kirillov, V. V. Travkin]

[Abstract] This article reports the design and test results for a superconducting circulating 2.8 Tesla solenoid 3.4 m in length. The solenoid is wound as a 2-channel conductor obtained by electrolytic splicing of two copper ports and an NT-50 NbTi alloy superconducting core together with four copper reinforcing conductors one mm in diameter. The solenoid consists of 68 coils of three standard sizes in ten sections. The total length of the superconducting cable is 6.36 km, coil weight is 2.7 tons and total mass of the solenoid cold section is 6.2 tons. The study also carries out an analysis of the mechanical stresses and deformations occurring within the coil, including mechanical winding stresses, thermomechanical forces resulting from coil cooling and pondermotive forces. Measurements of the integral compression factor of the conductor from cooling to nitrogen temperatures revealed essential anisotropy: 2.9 times 10^{-3}. System performance tests were carried out at a current of 3.72 kA producing a solenoid field of 2.83 Tesla and a stored energy of 7.6 MJ.

Magnetometer Based on a Sealed-Contact Reed Relay

18600119h Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian
No 5, Sep-Oct 88 pp 168-170

[Article by V. I. Datskov, V. M. Drobin, P. Lobotka]

[Abstract] This article reports the development of a magnetometer based on a KEM-2A sealed-contact reed relay for magnetic field measurements in the range .02-2 milliteslas. The unique design feature of this magnetometer is that the current flowing through the coil producing a secondary activated field is directly measured during the period where the contact is closed. No requirements are therefore imposed on the linearity of the magnetic field rise and fall. In this design the output display (a needle or digital display) shows the magnetic field strength and its sign. The sealed contact reed relay detects the absolute field magnitude. Hence the external field sign is not determined by the relay itself but rather by the field produced by the first coil in the magnetometer. The sign of the demagnetizing field of coil 2 will always be opposite that of the external, measured field. The magnetometer has been used successfully for measuring field distributions accurate to 10^{-3} in a Helmholtz system and residual fields from magnetic screens.

Magnetic Field Synthesis in Stratefied Media

18600168c Moscow ELEKTRICHESTVO in Russian
No 2, Feb 89 pp 88-90

[Article by Ye. A. Ivliyev, Yu. Ya. Iossel, L. A. Tseytlin]

[Abstract] This article considers the problem of obtaining prescribed magnetic fields in single-bounded domains of arbitrary form and proposes a method of synthesizing such fields based on the use of surface currents distributed appropriately along the boundaries of these domains. The analysis focuses on a system consisting of five layers whose boundaries are concentric spheres and is limited to the case where the magnetic susceptibilities of all layers are identical. Equations are derived to produce the scalar potentials of the magnetic field in the specific domains in these conditions. Two magnetic field patterns in the xz plane for the corresponding system currents in the domains are given; by superimposing these fields it is possible to obtain the resulting field pattern for the problem under analysis. This technique for obtaining prescribed magnetic fields in given domains is in principle applicable when the domains in which the prescribed field must be generated consist of separate subdomains with different magnetic susceptibilities. If the analysis is limited to cases where these domains have no extraneous currents it is evident that the single-connectedness requirement imposed earlier is no longer necessary. Specifically, in this case the entire analysis remains valid for any stratefied media in which the layer boundaries are infinitely long cylindrical surfaces with parallel generators.

Development of Superconducting Wires for Windings Employed to Generate Alternating Magnetic Fields

18600174f Moscow ELEKTROTEKHNIKA in Russian
No 12, Dec 88 pp 40-43

[Article by V. Ye. Sytnikov, I. B. Peshkov, G. G. Svalov, I. P. Radchenko]

[Abstract] This study analyzes the influence of structural and electrical properties of superconducting wire on the current density and dynamic energy losses in alternating magnetic fields. The study focuses on the current-carrying capacity of composite wires and the density level of the transport conductor on the relative current density. The study also optimizes the diameter of composite wires for minimum energy losses as a function of the impedance ratios. Certain recommendations are made on the basis of these analyses. The study recommends that in designing superconducting multi-wire conductors that a single-layer twisting technique be employed followed by shaping to achieve a rectangular cross-section producing a winding space factor of 0.85-0.9 in order to reduce dynamic energy losses, and to increase the transverse inter-conductor resistance.

Effect of Radiation on the Optical Properties of Vitreous Chalcogenide Semiconductor Fibers

18600111a Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 89 pp 28-31

[Article by A. Ya. Vinokurov, A. N. Garkavenko]

[Abstract] This study is devoted to an investigation of the effect of various forms of ionizing radiation on the optical properties of vitreous chalcogenide semiconductor fibers. Two types of optical fiber samples were analyzed: As_2S_3 and $As_{40}S_{32}Se_8$ specimens fabricated by melt drawing in an argon atmosphere. The specimens were 120 mcm in diameter and had no cladding. A scanning electron microscope analysis of the surface morphology of these specimens revealed a homogeneous surface with sparse isolated defects of an industrial nature (valleys and cavities). The samples were arradiated at a flux density of 3 times 10^{11} neutrons per cm^2 per second. The tests revealed a high radiation strength of the specimens. The induced optical losses are negligible for electron radiation at doses of up to 10^7 rad and neutron fluxes of up to 10^{15} neutrons per cm^2; optical losses increased across the entire spectral test range when the specimens were irradiated by electrons at doses of 10^{11} rad and neutron fluxes of 10^{17} neutrons per cm^2. Clearly these represent the ultimate values at which devices using such fibers can operate.

Numerical Modeling of an Optical Multistable Semiconductor Element with Two Competing Nonlinearity Mechanisms

18600111c Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 89 pp 77-80

[Article by Yu. I. Balkarey, A. V. Grigoryants]

[Abstract] This study provides results from an analysis of a mathematical model and numerical modeling of a bistable optical system accounting for possible spatially-inhomogeneous phenomena. The analysis focuses on a semiconductor Fabry-Perot interferometer with two dispersion optical nonlinearity mechanisms of opposite sign: a concentration mechanism and a thermal mechanism. The numerical analysis of the dynamics of a point system was carried out for parameter values characteristic of actual indium antimonide interferometers. Due to the substantial difference between the thermal and recombination times (5-6 orders of magnitude) special techniques developed for hard systems are required to solve the equation system. This study employed the Gear technique. The modeling results confirmed theoretical predictions. Self-sustaining oscillations in temperature, carrier concentration, and transmitted radiation with a period determined by the thermal time were obtained together with a wide variety of transient processes: switching from cycle to cycle under the influence of an external perturbation, from one cycle to a stable state, etc. The numerical modeling of traveling pulse shaping and propagation processes employed the finite difference method using an implicit Euler scheme. This study identified stable propagation of the reduced carrier concentration range: a "cold" pulse. Such a pulse would appear and vanish at distances of the order of 10 L_N upon initiation of a "hot" pulse. It was determined that carrier mobility could also be reduced by introducing additional impurities into the semiconductor. Fundamentally different spatially-inhomogeneous solutions may result: specifically, static separation of the kinetic variables.

Multifrequency Compressed Spectrum Microwave Holography

18600113j Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 33, No 11, Nov 88 pp 2452-2455

[Article by O. V. Bazarskiy, A. S. Glauberman]

[Abstract] This study considers a multifrequency compressed spectrum Fourier holography recording system. In this design the microwave radiation from an oscillator (approximately 75 GHz, λ equals 4 mm) passes through an isolation attenuator and a horn antenna which produces a plane wave which is radiated into free space. A dielectric lens and a ten-band fresnel lens with an identical aperture and focal distance as the dielectric lens are used as the focusing antenna. The spectrum of the object located at a distance of two- thirds of $f0$ was generated by a dielectric lens in the P1 plane and by the probe lens in the P2 plane. A scanning horn antenna is used to read the hologram. The received signal is mixed with the reference wave in a double T-bridge; the reference wave is then passed through a waveguide circuit by means of a coupler, an attenuator, a variable phase shifter, and a flexible waveguide. It was demonstrated that the test object was not recovered with acceptable resolution using this system in single-frequency holography conditions. In multifrequency holography an acceptable image recovery quality was achieved. Clear transmission of sharp angles is achieved by additional compression of the high spatial frequencies. It is therefore determined that multifrequency compressed spectrum microwave holography can be used to acquire satisfactory images with a resolution near the recording wavelength and can also be used for nondestructive monitoring and control

Physical Principles and Hardware Implementation of an Efficient Gas Discharge Laser Pump System

18600114a Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 88

[Article by G. A. Abilsiitov, O. G. Bulatov]

[Abstract] This article focuses on the development of an efficient pumping system for a relatively high-power gas-discharge laser. This design employs a crossed system of electrodes in order to produce discharges with good energy characteristics within large discharge chambers. A ballast-free power supply system for the crossed

electrodes makes it possible to combine excellent discharge parameters, high efficiency, etc. achieved by eliminating the resistive ballast with a simple electrode system design and a compact inverter-type power supply. The drawback of this system is the lower boundary (with respect to contributed power and operating frequency) of diffusion discharge. The contribution control range in diffusion discharge at operating pressures in nitrogen amounts to 30-100% of the nominal level.

An Industrial Pulse-Periodic CO_2 Laser

18600114b Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 88 pp 5-8

[Article by V. E. Gofman, V. V. Dembovetskiy]

[Abstract] This article provides results from scientific research and development of an industrial pulsed-periodic laser producing a mean output power of 2 kW, with a pulse energy of 1-4 J, a pulse duration of 10-50 mcs and a pulse repetition rate of up to 1200 Hz. This industrial CO_2)section approximately 1 m^3 in volume containing the pumping equipment, two discharge chambers, the cavity, a heat exchanger, and supports to the auxiliary systems: evacuation, gas feed, etc. In addition to pulse energy measurements the pulse waveforms and pulse duration in this system were also measured. Graphs of the laser pulse duration against gas composition and molecular component pressure are provided. Operation of the laser for a period of one year reveals the functional capability and reliability of the fundamental components and elements of this design. The service life of the circulation system, which was tested for over 1000 hours, is largely related to "aging" of the magnets mounted in half-couplings and the long-term viscosity of the ball-bearing lubricants; a service life of at least 5000 hours is claimed.

Thermophysical Problems of Laser Cutting of Dielectric Materials

18600114c Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 88 pp 13-16

[Article by S. G. Vologdina, V. M. Ganyuchenko]

[Abstract] This article develops a model of laser cutting of nontransparent dielectrics that accounts for the specific features of these phenomena and employs the model to identify industrial techniques that provide optimum cutting quality. Mathematically stability is represented by a singular solution of the corresponding nonlinear destruction problem for the quasistationary case, i.e., in coordinates related to the moving laser beam. The calculation is carried out in two steps. The Rosseland approximation is initially used to calculate the temperature dependence of the thermal conductivity of vitreous silica glass taking into account the actual spectral characteristic of the absorption coefficient and its temperature dependence. The numerical model is then used in conjunction with an explicit grid technique to investigate the quasistationary evaporation-induced breakdown of a flat wall under bombardment by a radiation flux of constant density. An analysis of the solutions to the various equations suggests that one or two solutions of the equation system (the set of geometric parameters of the cutting surface) are possible in these conditions depending on the relative rate of material destruction and the angle of incidence. These solutions correspond to stable or unstable material treatment conditions. Graphs are given to illustrate the results from a calculation of geometric cutting parameters and melt layer thickness for cutting vitreous silica glass with α equal to $\pi/3$.

Performance Optimization of the LN-1.2N0-I1 Laser Installation

18600114d Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 88 pp 24-26

[Article by A. Ya. Britva, V. A. Myakushin]

[Abstract] This article presents results from an investigation of the electrical efficiency of the LN-1.2NO-I1 industrial laser set. This laser set employs convective cooling of the active medium by fast (up to 50 m/sec) pumping and partial recovery of the gas media (CO_2, N_2, He). The laser active medium is glow-discharge excited in a two-electrode system transverse to the gas flow. This research is used as the basis for developing recommendations on the operating conditions of the LN-1.2No-I1 laser set. The maximum current is 15 to 16 amps for the total pressure of 2.13 kP (for a Co_2: N_2: He ratio of 1:4:3) and electrodes 90 cm in length along the active medium. The current can be used to control radiation power over a 1.2- 1.3 to 2 kW range. In this case the maximum efficiency (10-11 percent) lies in the 1.2-1.3 kW power range. In order to achieve lower radiation power it is necessary to adopt lower working pressures, which serves to reduce efficiency. The current diminishes in this case while the pump flow rate required for maximum efficiency increases. The selection of the operating pressure range must account for the capability to rapidly control radiation power within a specific range by means of the discharge current. The center of the range will coincide with optimum energy contribution for the given working pressure.

CO_2 Laser Power Supplies

18600114e Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 88 pp 30-34

[Article by V. K. Lebedev, V. D. Shelyagin]

[Abstract] This is a survey article of the various power supplies used with CO_2 lasers. It is determined that CO_2 laser beam parameters are stable if the power supply provides the necessary uniformity of current distribution in the gas-discharge chamber. Several CO_2 laser designs are analyzed and it is noted that the highest radiation power is attained in electron beam-sustained (non-self-sustained) discharge. Two power supplies are used for such lasers: a relatively low-voltage power supply

providing energy for the gas-discharge and a high-voltage power supply used for the electron beam gun which produces a homogeneous electron beam accelerated by a 100- 250 kV voltage. In order to attain stability of gas discharge this article recommends diode guns to maintain a uniform current density distribution in the beam cross-section. In this case the beam current will be regulated by varying the accelerated voltage in a range from 30-100 percent either continuously or in steps. This survey of published studies indicates that the search for more efficient laser power supplies continues. It is anticipated that d.c. power supplies employing auxiliary pulsed or RF excitation will be used in the future for longitudinal-flow lasers, while high-frequency AC power supply systems will be used for transverse-flow lasers.

Laser Set Power Supply

18600114f Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 88 pp 34-47

[Article by A. G. Aizenshteyn, A. Ya. Britva]

[Abstract] This article discusses the power supply characteristics in the LN- 1.2NO-I1 industrial laser set. This is an electric discharge, convectively-cooled CO_2 laser producing an output power of 1.2 kW. The laser active medium is excited by d.c. glow discharge in a variety of gas mixtures. The glow discharge is excited between two electrodes transverse to the gas flow. The gas flow rate is 10-50 m/sec. The laser electrode system includes a tubular cathode (15 mm in diameter) and a flat anode (100 mm along the flow). The electrodes are water-cooled and are 900 mm long along the optical axis of the cavity. Analysis of this system indicates that it is possible to construct a power supply to support operation of the laser set with rapid transitions between glow discharge and arc discharge and for discharge current stabilization without using ballast resistors by employing a thyristor converter equipped with a smoothing choke and a special controller. These results can be used to develop power supplies for industrial laser sets that improve their efficiency and reduce their size and weight.

Stabilized Power Supplies for Industrial Gas-Discharge Lasers

18600114g Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 88 pp 37-38

[Article by V. A. Garasimov, S. Yu. Gershteyn]

[Abstract] This article focuses on the design principles and specifications of the UPU-2-30 power supply and controller used in the LN1.2-NO-I1 gas-discharge industrial laser. The power section of the UPU-2-30 consists of two channels. The primary channel contains a thyratron regulator on the primary winding side of a step-up transformer, fixed three-phase rectifiers in series on the secondary winding side and a T-smoothing filter. The power supply operates in a current stabilization mode. The preionization channel generates output high-voltage pulses of a given amplitude and duration with a rather low pulse repetition rate. The preionization pulses are generated by discharge from a pre-charged capacitor bank through a thyristor switch into a pulse transformer. The primary specifications of the UPU-2-30 power supply are provided in the article.

Interrelationship Between the Dynamic and Static Characteristics of Irradiated Bipolar Power Transistor Structures

18600114h Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 88 pp 45-47

[Article by P. F. Lugakov, Yu. M. Pokotilo]

[Abstract] This article examines the relationship between the static and dynamic parameters of bipolar power transistors under irradiation. The test structures took the form of transistors fabricated by the basic technology (three-stage diffusion of aluminum, boron, and phosphorus through the *n*-layer of epitaxial n-n^+ structures). These transistor structures were irradiated by various types of radiation: ^{60}Co γ-quanta, 4.5 MeV electrons, fast reactor neutrons and 5 MeV alpha-particles; these have a varying degree of efficiency with respect to producing radiation defects in silicon and produce both point defects in the devices as well as accumulation areas. The transistor structure parameters were measured before and after irradiation. The theoretical analysis revealed that the radiation-induced change in the current gain in saturation conditions is determined primarily by the collector layer parameters, at the same time that in an active mode it is determined primarily by the parameters of the active base and the space-charge layer of the emitter junction. The substantial difference in the degree of radiation-induced change in β as a function of the type and energy of ionizing radiation is attributed to the various formation efficiencies of radiation defects in the devices.

Integrated Magnetic Levitation and Acceleration System for High-Speed Rail Transport

18600114j Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 88 pp 60-63

[Article by N. M. Novogrenko, M. B. Bondarenko]

[Abstract] Over the past several years the All-Union Electrotechnical Scientific Research Institute has conducted a theoretical and experimental analysis of the levitation characteristics for various magnetic field railroad suspension designs used in the MLU-001 system (Japan). This research was conducted in order to determine the design and configuration that provide the best levitation quality with a limited number of magnetic field sources. Many different high-speed rail transport systems were analyzed and compared, including the HSST-3 system (Japan), the Transrapid 07 system (The Federal Republic of Germany), and the MLU-001 system (Japan). These systems were used as the basis for

determining acceptable engineering parameters for the power electronic systems for the entire high-speed elevated rail transport system, including static converters, current pick-off, power supply, and substations. The engineering and cost analysis of the integrated system in a first approximation suggested that it is advisable to construct lines with a payback period of 7-8 years and at a cost of the order of 5 million rubles per kilometer of two-way line.

Optical Remotely-Tunable Echo Spectrometer

18600119i Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian
No 5, Sep-Oct 88 pp 172-174

[Article by I. S. Bikbov, I. I. Popov, V. V. Samartsev]

[Abstract] This article describes the design and operating principles of an optical echo spectrometer whose excitation radiation can be remotely tuned. In this design, two laser pulses separated in time and with identical wave vectors are generated in one cavity of a tunable dye laser consisting of dye cuvettes, an outcoupling mirror and diffraction gratings. Frequency tuning is achieved by rotating one grating about the axis parallel to the grooves; the array is driven through a reduction gear from an electric motor controlled from a remote control panel. The echo spectrometer can be used to record the relative intensities of a light echo signal and of excitation laser pulses, to measure the frequency dependence of the echo signal amplitude and the dependence of the echo signal intensities on the time intervals between exciting pulses. The spectrometer parameters include: excitation pulse duration: 10-15 ns, excitation radiation linewidth: 0.1 nm, spectrometer frequency range: 400-800 nm, tuning range: 560-600 nm.

Automated Surface Acoustical Wave Velocity Measurement Technique for Application to Piezoelectric Crystal Wafers

18600119j Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian
No 5, Sep-Oct 88 pp 174-176

[Article by A. N. Annenkov, I. A. Bunin, A. V. Dobriyan, V. D. Ligun, N. G. Sorokin, S. I. Chizhikov]

[Abstract] This article proposes a surface acoustical wave velocity technique for an automated installation that employs a continuous phase method based on measurement of the amplitude-frequency response of a two-port formed by two identical interdigital converters in a common acoustic channel. Overlapping broadband interdigital converters with a 30 MHz central frequency mounted on a plane-parallel glass wafer at a fixed distance s were employed to excite and detect the surface acoustical waves in this design. This method and assembly were used to measure the temperature coefficients of the effective velocity of surface acoustical waves in Y-127°-cut lithium niobate with various Li and Nb ratios. The temperature coefficient of the velocity remained nearly unchanged at (69-71) times 10^{-6}1/°C for all test compositions. This technique can be used to measure surface acoustical wave velocity on both a free wafer surface and on a metallized surface, thereby yielding the electromechanical coupling factor.

Model of the Liquid Development of Positive Polymer Resists Systems

18600130a Moscow MIKROELEKTRONIKA in Russian Vol 18, No 1, Jan 88 pp 15-21

[Article by V. N. Genkin, M. Yu. Mylnikov]

[Abstract] This article incorporates multiple factors such as the molecular- mass distributions, development time and dissolution rate in optimizing the liquid development of positive electron resists. A model based on a representation of the diffusion mechanism of the dissolution of polymer molecules is developed; this model takes into account the molecular-mass distribution in the polymer. This model is then applied to the electron-lithographic process while the dependence of the thickness of the polymer film remaining after exposure and development on the irradiation dosage is found. The derived equations are used to obtain the contrasts of the resists for various solvent quality levels and it is determined that the contrast is only weakly dependent on the development quality. The Flory and Schultz distributions are used for comparison; a good agreement with experiment is obtained for the Schultz distribution.

Method of Designing Self-Testing Array LSICs

18600130b Moscow MIKROELEKTRONIKA in Russian Vol 18, No 1, Jan 88 pp 43-49

[Article by A. M. Merenkov, A. P. Panfilov]

[Abstract] This article develops a modified structural method of designing self-testing array LSICs. This is a modernized structural technique that envisages built-in self-testing capability and is oriented for the specific aspects of designing LSICs and differs from existing methods in that an exhaustive functional self-testing of all combination equivalents of the initial LSIC circuit is carried out. When the proposed set of self-testing elements is used the hardware outlay is reduced by a factor of 1.5 to 2 compared to existing techniques, while expenditures on LSIC testing drop significantly and testing equipment is substantially simplified. The high degree of formalization of this technique makes it possible to automate the self-testing LSIC design routine within the framework of existing LSIC computer-aided design systems. The LSICs can be tested not only during the inspection-rejection stage, but also in an operating system which makes it possible to resolve one of the most difficult problems in developing failure-free equipment.

Method of Measuring Gyromagnetic Film Parameters

18600130c Moscow MIKROELEKTRONIKA in Russian Vol 18, No 1, Jan 88 pp 61-65

[Article by A. V. Voronenko, S. V. Gerus, L. A. Krasnozhen]

[Abstract] This study presents a method of measuring such parameters of gyromagnetic films as the saturation magnetization, thickness, growing and crystallographic anisotropy fields and the angle of deviation of the growing axis from the perpendicular to the film plane. The analysis employs a zero-exchange approximation and a magnetostatic approximation. The calculations take into account the Zeeman energy, the dipole-dipole interaction energy and the anisotropy energy. The method is based on investigating the orientation dispersion relations of the surface magnetostatic waves propagating in the magnetic film. The derived experimental data are compared to relations calculated using a magnetic film model in order to determine the parameters of the test specimen. The dispersion relations of the surface magnetostatic waves are measured by Bragg scattering of these waves by magnetic gratings. The proposed method makes it possible to measure all the most important parameters of magnetic films and, moreover, is a non-destructive technique, unlike many other methods.

Analysis of Conditions for Stable Vertical Bloch Line Advancement in a Storage Register

18600130d Moscow MIKROELEKTRONIKA in Russian Vol 18 No 1, Jan 88 pp 72-77

[Article by V. G. Redko]

[Abstract] The purpose of this study is to obtain adequate analytic estimates of the conditions of the conditions for reliable advancement of vertical Bloch lines in a data storage register. A reduced description model underlies the calculation. The numerical calculation carried out within the framework of this model demonstrated that the amplitudes of the required trapezoidal pulses are approximately the same as the amplitudes of square-wave pulses. The derived estimates are applicable for trapezoidal pulses with short leading edges. The time interval between the field pulses must be significantly greater than the characteristic relaxation time of the vertical Bloch lines. The field gradients required for vertical Bloch line advancement are calculated and estimates of the minimum fields corresponding to the two control techniques and two register designs are provided. The analysis demonstrates that the speed of the register may reach 10 MHz.

A Silicon-Silicon Carbide-Metal Internal Gain Photodetector

18600130e Moscow MIKROELEKTRONIKA in Russian Vol 18, No 1, Jan 88 pp 88-90

[Article by A. G. Gasanov, V. M. Golovin, Z. Ya. Sadygov, Yu. N. Yusipov]

[Abstract] This study presents experimental results from an investigation of the possibility of fabricating internal gain photodetectors based on multilayered silicon-silicon carbide-metal structures. The photodetector specimens were fabricated on a p-type silicon substrate with

an acceptor concentration Na is approximately equal to 1.5 times 10^{15} cm^{-3}. The SiC layer of 0.15 mcm thickness was applied to the substrate by ion-plasma spraying. Titanium or nickel layers applied to the silicon carbide (such layers are semitransparent to light) were used as the metallic electrode. A thin aluminum layer was applied along the perimeter of the semitransparent electrodes in order to reduce their resistance. The ohmic contact on the specimens was fabricated on the opposite side of the silicon substrate. The tests revealed that these photodetector specimens of 25 mm^2 in area will operate stably for greater than 100 hours at a gain of 100 to 200. The characteristic photocurrent pulse rise time is limited by the capacitor charge time of the specimens and normally runs near 20 ns. The analysis demonstrates that Si-SiC-metal structures can be used to fabricate highly-sensitive and high-speed photodetector specimens of substantial area that can be applied to recording weak luminous fluxes.

Investigation of Human Internal Temperature Distribution Under Ultrasound Irradiation

18600173c IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 31, No 11, Dec 89 pp 1437-1441

[Article by V. S. Troitskiy, V. L. Rakhlin, E. P. Razvozova]

[Abstract] This study investigates the local heating action of ultrasound on the human internal temperature of various tissues and organs within the human body. The internal temperature measurements were carried out by the RF thermometer developed at the Gorkiy Scientific Research Institute of Radiophysics; this device can be used for noninvasive measurement of the mean temperature of muscle tissue to depths of up to 5 cm accurate to plus or minus 0.1 degree C for 5 seconds based on the intensity of natural thermal radioemission from tissues in the λ equals 30-60 cm range. The tests were carried out by ultrasound irradiation of the upper thigh or arm areas. Internal temperature was initially measured prior to irradiation and immediately after a 5 minute exposure, then after a 15 minute and 1 hour exposure. The temperature measurements were carried out in the actual exposure area and symmetrical regions. The derived data set suggest that the decreasing tissue temperature caused by ultrasound activity is due to the diminishing metabolism in the tissues. This process is controlled by the central nervous system by sending signals to other systems and body organs. This new experimental technique can be used to reliably detect the previously-unknown response of living human tissue which is manifested as a diminishing temperature of the area irradiated by ultrasound and in a symmetrical local adjacent area.

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